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Sabellidae, Serpulidae and Spirorbinae (Polychaeta sedentaria) from the Barremian (Lower Cretaceous) of the Serre de Bleyton (Drôme, SE France)

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(With 10 plates and 1 figure)

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Abstract

The Barremian of the Serre de Bleyton has yielded many calcareous tubes and tube fragments of a diverse polychaete fauna of circa 20 species, many of them new to science. One new genus, *Pseudomicrorbis* nov. gen., and seven new species are introduced, *Metavermilia* (*Vepreculina*) *infracretacea* nov. spec., *Filogranula*? *provencalis* nov. spec., *Mucroserpula pentaditrupoidea* nov. spec., *Mucroserpula*? *bleytonensis* nov. spec., *Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* nov. spec., *Pseudomicrorbis pseudomicrorbis* nov. spec. and *Neomicrorbis barremiensis* nov. spec.

Compared to the Upper Jurassic and especially the Upper Cretaceous, the Lower Cretaceous sabellid and serpulid fauna has so far received comparatively little attention. This Barremian fauna fills a stratigraphical gap from which only few sabellids and serpulids had been described so far. The high percentage of new species is due to the fact that most of the Lower Cretaceous sabellid and serpulid faunas described till now are found in the boreal realm, thus explaining the outstanding high diversity of the Tethyal Serre de Bleyton fauna compared to that of Germany and England.

The high diverse fauna includes both surprisingly modern elements as well as “old-fashioned” forms resembling Jurassic species. On the one hand, one of the geologically earliest representatives of *Pyrgopolon* and a relatively diverse fauna of small spirorbins were found here. On the other hand, the sabellid *Glomerula* and the serpulids *Serpula* (*Cementula*) and *Mucroserpula* resemble Jurassic species, although the Barremian specimens are usually smaller than the Jurassic tubes.

Keywords: Polychaeta, Sabellidae, Serpulidae, Spirorbinae, new species, Lower Cretaceous, Barremian, France

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Zusammenfassung

Aus dem Barremium der Serre de Bleyton stammen zahlreiche Kalk-Röhren und Röhrenfragmente einer diversen Polychaetenfauna. Diese Fauna enthält circa 20 Arten. Eine neue Gattung, *Pseudomicrorbis* nov. gen., und sieben neue Arten werden eingeführt: *Metavermilia* (*Vepreculina*) *infracretacea* nov. spec., *Filogranula*? *provencalis* nov. spec., *Mucroserpula pentaditrupoidea* nov. spec., *Mucroserpula*? *bleytonensis* nov. spec., *Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* nov. spec., *Pseudomicrorbis pseudomicrorbis* nov. spec. und *Neomicrorbis barremiensis* nov. spec.

Im Vergleich zum Ober-Jura und vor allem zur Ober-Kreide hat die Sabelliden- und Serpulidenfauna der Unter-Kreide bisher verhältnismäßig geringe Beachtung gefunden. Die vorliegende Fauna aus dem Barremium füllt eine stratigraphische Lücke, aus der bisher relativ wenige Sabelliden und Serpuliden beschrieben wurden. Der hohe Anteil neuer Arten beruht vor allem darauf, dass die meisten der bisher beschriebenen unterkretazischen Sabelliden- und Serpulidenfaunen aus borealen Fundstellen stammen. Letzteres erklärt die außergewöhnlich hohe Diversität der Tethyalen Fauna der Serre de Bleyton im Vergleich zu der Fauna aus Deutschland und England.

Die hochdiverse Fauna enthält sowohl überraschend moderne Element als auch “altmodische” Formen, die an jurassische Arten erinnern. Einerseits wurden hier einige der geologisch frühesten Vertreter von *Pyrgopolon* und eine relativ diverse Fauna kleiner Spirorbinae gefunden. Andererseits erinnert die Sabellide *Glomerula* und die Serpuliden *Serpula* (*Cementula*) and *Mucroserpula* an jurassische Arten, obwohl die Exemplare aus dem Barremium überwiegend kleiner sind als die Röhren aus dem Jura.

Schlüsselworte: Polychaeta, Sabellidae, Serpulidae, Spirorbinae, neue Taxa, Unter-Kreide, Barremium, Frankreich

Introduction

Compared to the Upper Jurassic and Upper Cretaceous serpulid faunas, Lower Cretaceous serpulids have received relatively little attention yet. This is especially true for the Barremian middle portion of the Lower Cretaceous bracketed between the Valanginian/Hauterivian which is represented by highly fossiliferous claystones and marlstones in France, Switzerland and north Germany and the fossiliferous Aptian and Albian “greensands” of south England. Hauterivian serpulids were described, e. g., by Regenhardt (1961); Upper Aptian serpulids, e. g., by Ware (1975). However, those faunas are from the boreal realm and thus yield a smaller number of species compared to the very high diverse Barremian fauna of the Tethyan realm at the Serre de Bleyton described below.

In Europe, Barremian sediments are mainly represented by claystones in the boreal realm of England and north Germany and by pelagic limestones in the Tethyan realm. Both are relatively rare in fossils except for microfossils, cephalopods and fish remains. In SE France, Barremian sediments are known either in the form of well-cemented Urgonian limestones from which fossils can barely be isolated or as pelagic to hemipelagic deposits usually poor in macrofossils. The Barremian fauna found in turbiditic horizons at the

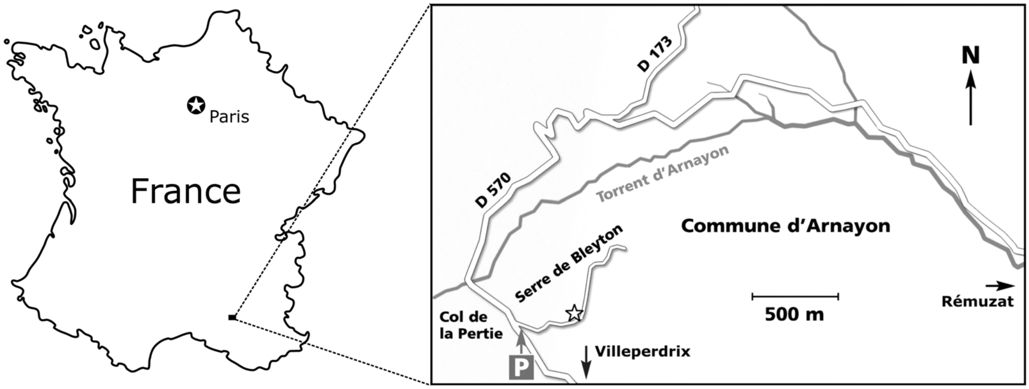

Fig. 1. Map showing the position of the sites at the Serre de Bleyton (asterisk).

Serre de Bleyton is a very local exception to the rule, because it is highly fossiliferous and the fossils are more or less isolated from the matrix by natural weathering.

Study Area and Geological Setting

Within the pelagic to hemipelagic Barremian sediments of SE France, siliciclastic and turbiditic channel fillings and fan structures occur. At the southern slope of the Serre de Bleyton ridge, at least two such turbiditic horizons interpreted to represent basin-floor fans yielded a rich and extremely diverse fauna. The bioclasts are transported from the Provence Platform into the Vocontian Basin, size-sorted and in part reworked and worn (ADATTE et al. 2005; ARNAUD 2005; KROH et al. 2010).

The material described in this paper comes from three closely spaced sites, SdB1, SdB2 and SdB3 (for GPS data see KROH et al. 2010), situated beside a gravel road at the southern slope of the Serre de Bleyton (Fig. 1), a low hill in front of the Serre Malivert, east of the Col de Pertie, Commune d'Arnayon, Department Drôme, approximately 90 km northnortheast of Avignon, SE France. The nearest villages are Arnayon and Berlieres in the east and Léoux in the south; larger villages are Villeperdrix and Rémuzat in the south. MOOSLEITNER (2007) has described the geological situation in detail. The three sites are very small. The main site, SdB1, is only 50 cm wide and 15 cm high. The fossils, usually less than 20 mm in diameter and 35 mm at maximum, are derived from a shallow marine habitat and are concentrated in the basal bioclastic limestone breccia of a turbidite which is intercalated between pelagic or hemipelagic limestone layers deposited in deeper shelf environment.

At the sites just mentioned the rock had become friable by natural weathering so that the highly diverse mesofauna could be isolated from the matrix. In contrast to the disarticulated but often well-preserved skeletal elements of the crinoid fauna (JÄGER 2010), many of the calcareous polychaete tubes are worn (broken into pieces, damaged or abraded) and partly obscured by firmly adhering sediment particles or bioclasts. However, some serpulids adapted to small substrates or soft ground (two of the *Filograna* specimens and all *Nogrobs* and *Rotulispira* specimens) had been embedded in finer-grained sediment and are better preserved.

The foraminifer fauna of the turbidite studied by Dr. Annie Arnaud-Vanneau, Laboratoire de Geodynamique des Chaines Alpines, Grenoble (Moosleitner 2007, p. 293) is Barremian, possibly late Barremian in age. According to studies on the cephalopods (Janssen 2010; Lukeneder 2010), SdB1 and SdB2 are Barremian, possibly late Barremian, and SdB3 (where a single *Rotulispira* specimen was the only serpulid found) is early Barremian.

Materials and Methods

Gero Moosleitner took bulk samples repeatedly, washed and sieved them, picked the fossils under a binocular microscope and treated them with Rewoquat® for cleaning (Lierl 1992), sorted them roughly into zoological groups and sent them to specialists. The majority of the calcareous tube polychaetes is cemented to a solid substrate (a bioclast or a piece of rock), and many of the fossil specimens are combinations of polychaete remains with the remains of corals or bryozoans or oysters, etc. Therefore, Moosleitner had to decide for each specimen if to send it either to the respective specialist of corals or bryozoans or oysters etc. or to the author. For this reason, the author has not seen some of the polychaete remains recovered, but certainly nearly all of the better-preserved and most interesting species. Moreover, as some of the small-sized gastropods resemble spirorbin serpulids, a few errors in sorting have occurred.

The author first sorted the specimens into morphologically different groups, and then tried to determine them, using descriptions and figures of related taxa in the literature. The systematics and taxonomy largely follow that of Jäger (2005) and ten Hove & Kupriyanova (2009).

There are several biases in counting specimens. Most specimens are only tube fragments, and each fragment is counted as one unit. A considerable number of specimens is too badly preserved for taxonomic determination. Many specimens are only steinkerns. The author sorted the material several times, and every time the result differed a bit in detail from the one before! In some worn and broken fossils it was even difficult to decide if they belong to polychaetes or to other invertebrates.

In the material lists, the fossils are counted as "specimens", this means "pieces". In many of these "specimens", two or more tubes of the same species are fixed together on the same piece of rock. In some taxa the individual tubes were counted as "individuals". The stronger the tendency of the larvae of a species to settle on a common substrate, the larger the difference between figures of "individuals" and "specimens". If tubes of different taxa are fixed together on the same substrate, then this fossil is counted as a "specimen" in the material lists of each of the polychaete taxa involved. In consequence, the addition of figures of specimens listed in each taxon amounts to a larger sum than the total number of physical pieces.

An uncertainty in determination is caused by the fact that the tube structure had not been studied in more detail than what is visible under a binocular microscope, and presumably the tube structure had been altered by diagenesis. Therefore the possibility can not be ruled out that some of the spiral tubes described below, especially those lacking an umbilicus and longitudinal ornaments, could represent some of the geologically latest microconchids (see TAYLOR & VINN 2006) instead of spirorbin serpulids. Nevertheless, at least the ornamented and widely umbilicated spirals resemble true spirorbin serpulids much more. Another problem is that in the present paper, "Spirorbinae, gen. and sp. indet." acts as a dustbin taxon to include all small spirorbin-shaped remains lacking distinct ornament.

In contrast to the crinoids which are usually clean of sediment after treatment with Rewoquat®, it was often hardly possible to remove adhering sediment grains or bioclasts from the polychaete tubes, and therefore some adhering sediment grains and bioclasts are visible on the photographs.

All material from the Serre de Bleyton studied by the author is contained in the collections of the department of Geology and Palaeontology at the Natural History Museum Vienna (NHMW).

Abbreviations

D = diameter; H = height; L = length; W = width; prefix L = loop; prefix S = spiral; prefix T = tube; SdB1, SdB2 and SdB3 = sites 1, 2 and 3 at the Serre de Bleyton.

Systematic Palaeontology

Class Polychaeta GRUBE, 1850

Subclass Canalipalpata ROUSE & FAUCHALD, 1997

Order Sabellida FAUCHALD, 1977

Family Sabellidae LATREILLE, 1825

Subfamily Sabellinae CHAMBERLIN, 1919

Genus *Glomerula* BRÜNNICH NIELSEN, 1931

Glomerula serpentina (GOLDFUSS, 1831)
(Pl. 1, Figs 1–7)

1831 *Serpula gordialis* SCHLOTH. Varietas *serpentina*. – GOLDFUSS: p. 240, Pl. 71, Fig. 4.
pars 1983 *Glomerula gordialis* (SCHLOTHEIM, 1820). – JÄGER, pp. 26–31, Pl. 2, Figs 1–18. [cum syn.]
2005 *Glomerula serpentina* (GOLDFUSS, 1831). – JÄGER, p. 130, Pl. 1, Fig. 1. [cum syn.]
2007 *Glomerula serpentina* (GOLDFUSS). – MOOSLEITNER: Pl. 10, Fig. 7 (pars).
2007 *Glomerula lombricus* (DEFRANCE). – MOOSLEITNER: Pl. 10, Figs 3, 11 (pars), 12.

Material: SdB1: 322 specimens (many individuals; NHMW 2010/0021/0001–0002, .../0004–0007, .../0077–0078). SdB2: 52 specimens (many individuals; NHMW 2010/0021/0003, .../0079–0081).

Description: The *Glomerula* tubes from the SdB agree in morphology with Late Cretaceous and Danian specimens described in many papers (e. g., JÄGER 1983, 1993, 2005). The tubes form the usual meanders (Pl. 1, Fig. 3), knots (Pl. 1, Figs 1–2 and 5–6) and, less often, rather regular spirals (Pl. 1, Fig. 4). A number of specimens consist of more than one individual (Pl. 1, Fig. 2). In some specimens a considerable number of tubes are densely crowded to form clusters (Pl. 1, Fig. 5). The largest cluster is 13 mm in D. Fragments of the free tube portion are rare (Pl. 1, Fig. 7). In two specimens such a free portion is overgrown all around by the anterior tube portions of the same individual.

In most tubes TD is less than 1.0 mm, but in circa 5–10 per cent of the tubes TD is larger, up to 1.8 mm at maximum. However, the size spectrum is continuous, the frequency range of TDs shows only a single peak. Only a few specimens show that the tube wall consists of at least two layers (Pl. 1, Fig. 7a) which sometimes are arranged eccentrically with a crescent-shaped interstice in between. In at least one specimen a slightly smaller tube is growing out of the lumen of a broken tube. Four tubes show a trilobate constriction of the lumen, even though none is well enough preserved for photography. Other special tube features known from other localities (compare JÄGER 1983, 1993, 2005) are not met with in the SdB material; this may in part be due to the moderate preservation.

Discussion: According to the presence of trilobate constrictions of the lumen, the SdB *Glomerula* belongs to the relative "modern" *G. serpentina* in the scheme of JÄGER (2005). (The oldest known occurrence of trilobate constriction has shifted down from Lower Hauterivian (JÄGER 2005) to Upper Valanginian; undescribed material from the Wąwal claypit in central Poland donated by MARIUSZ SALAMON.) Moreover, some *Glomerula* specimens from the SdB show another relatively "modern" feature: the very narrow curvature of the tubes (Pl. 1, Fig. 6).

As the frequency range of TDs of *Glomerula* tubes from the SdB shows only a single peak, all these *Glomerula* specimens are considered to belong to a single species, *G. serpentina*. This is the usual situation with specimens living in agitated shallow water and in contrast to the situation in offshore chalk facies, where the frequency range of TDs of *Glomerula* shows two peaks separated by a minimum (Jäger 1983, 2005) and where the small-sized specimens are discriminated as a separate species, *Glomerula lombricus* (Defrance, 1827b).

Although a number of specimens include several tubes densely crowded to form a cluster, these are not considered to represent a separate species, *G. plexus* (J. de C. Sowerby, 1829), because typical *G. plexus* specimens are composed of dozens or hundreds of tubes. Moreover, a few aggregates composed of many but small tubes are determined as irregular specimens of *Filograna filosa*.

In tubes forming a regular planar spiral, discrimination between *Glomerula* and *Serpula* (*Cementula*) may be difficult, if only the steinkern is preserved.

Occurrence: Valanginian to Late Eocene, widespread and common in marine habitats.

Family Serpulidae Rafinesque, 1815

Subfamily Serpulinae Rafinesque, 1815

Genus *Filograna* Oken, 1815

Filograna filosa (Dujardin, 1837)
(Pl. 1, Figs 10–11)

1837 *Serpula filosa*, Duj. – Dujardin: p. 233, Pl. 17, Fig. 18.
1983 *Filograna filosa* (Dujardin, 1837). – Jäger: pp.19–20, Pl. 1, Figs 1–2. [cum syn.]
2005 *Filograna filosa* (Dujardin, 1837). – Jäger: p. 134, Pl. 1, Figs 16–17. [cum syn.]
2007 *Filograna filosa* (Dujardin). – Moosleitner: Pl. 10, Fig. 1.

Material: SdB1: 21 fragments of bundles (NHMW 2010/0021/0010, .../0085). SdB2: 115 fragments of bundles (NHMW 2010/0021/0011/, .../0086–0089).

Description: TD is 0.3–0.6 mm. The tube wall is moderately thin. The tubes are only moderately deformed at their base, and the lumen is circular (Pl. 1, Fig. 11a). One example of Y-shaped ramification of the single tube due to asexual reproduction has been observed, but it was accidentally destroyed during preparation.

The specimens from the SdB are fragments of more or less cylindrical bundles composed of a great number of tubes growing more or less parallel upon each other (Pl. 1, Fig. 10). Maximum L of bundle fragments is 23 mm, largest bundle D is 10 mm. Some bundles are Y-shaped or T-shaped ramified (Pl. 1, Fig. 11b). In some bundles, the tubes are not arranged parallel to each other at all, but are curved very irregularly.

Discussion: According to the simple and artificial scheme of Jäger (1983, 2005), the *Filograna* specimens from the SdB belong to a single species, *F. filosa*.

The ordinary bundle shape of the SdB specimens is the same as in other Jurassic and Cretaceous *Filograna* specimens. A few SdB bundles in which the tubes are not arranged parallel to each other resemble *Glomerula*. However, the TD is smaller than usual for *Glomerula* clusters.

Only one *Filograna filosa* bundle shows indistinct traces of originally having been fixed to a no longer preserved substrate. Normally the bundles must have grown freely and presumably more or less vertically.

Often many small tubes of *Metavermilia* (*Vepreculina*) *infracretacea* nov. spec. encrust a common substrate forming an irregular pattern which may resemble an early phase of colonization of living *Filograna* tubes. However, these *Vepreculina* tubes can easily be distinguished from *Filograna* by their longitudinal ornament and, most of all, by their common annular peristomes. The SdB material provides no clear information about the initial phase of colony growth of *Filograna*.

Occurrence: Oxfordian to Late Maastrichtian, widespread and common in shallow marine habitats.

Genus *Nogrobs* de Montfort, 1808

***Nogrobs* sp.**
(Pl. 2, Figs 1–2)

Material: SdB1: 2 fragments (NHMW 2010/0021/0012–0013).

Description: Both specimens are broken at both ends and are not fixed to a substrate. They are nearly straight, only very slightly curved. L is 6.9 mm and 7.5 mm, respectively. W is 1.4 mm in both specimens. The shorter specimen (Pl. 2, Fig. 2) has a square cross-section a both ends, and the longer one (Pl. 2, Fig. 1) has a square cross-section at the one (presumed posterior) end, but a circular cross-section at the other (presumed anterior) end, a fact which is unusual to non-spiral *Nogrobs* specimens. The boundary between the short square and the long circular tube portions is at a weak but distinct peristome combined with a slight torsion situated circa 2 mm in front of the square cross-section. Moreover, this specimen has two even weaker peristomes (or only strong incremental lines) in the circular tube portion. These transversal elements run exactly perpendicular to the tube's longitudinal axis.

The three available square cross-sections are nearly perfect in geometry. They have sharp angles, resulting in sharp longitudinal edges on the surface. The upper side of the square is straight in the shorter specimen and slightly convex in the longer specimen. The latera and the underside are very slightly concave in the shorter specimen and more or less plain in the longer specimen. Only at the circular cross-section, the lumen is slightly eccentric. The lumen is always circular.

The tube wall is moderately thick. In the shorter specimen, there can be distinguished a darker outer layer which is thick at the edges and thin between the edges so that its inner border is circular, a brighter inner layer of constant thickness and a very thin darker innermost layer which is only developed at one of the two cross-sections. However, in the square as well as in the circular cross-section of the longer specimen, no darker outer and brighter circular layer can be distinguished, instead there is one homogenous bright layer. But there is a very thin slightly darker innermost layer like in one of the two cross-sections of the shorter specimen.

Discussion: Several non-spiral *Nogrobs* species with a square cross-section are common in the boreal Lower Cretaceous where they occur mainly in clay facies. The occurrence of *Nogrobs* in material derived from shallow marine habitats as well as the occurrence of a circular cross-section in a non-spiral *Nogrobs* species is unusual.

Genus *Rotulispira* CHIPLONKAR & TAPASWI, 1973

***Rotulispira* sp.**
(Pl. 2, Figs 3–5)

2007 *Rotulispira* sp. – MOOSLEITNER: Pl. 10, Fig. 4.

Material: SdB1: 5 specimens (2010/0021/0014–0015, .../0090). SdB3: 1 specimen (NHMW 2010/0021/0016).

Description: First, the specimen from SdB3 (Pl. 2, Fig. 5) is described in detail. It is large, well preserved on the upper side, but somewhat damaged on the underside. The tube forms a plane dextral spiral consisting of at least 2½ whorls, maybe more, because the innermost whorls are still covered by sediment. SD is 12 mm, SW only 2.5 mm. The umbilicus is wide: 52.5 per cent. The border of the umbilicus is gently sloping. Only a 2 mm long portion of the free tube portion is preserved. In lifetime, the free tube portion was presumably oriented in the same plane as the spiral, although it is directing obliquely downward now due to diagenetic deformation.

At the end of the spiral TH is 3 mm. The anterior cross-section is rounded triangular, and TW is 2.5 mm. The tube wall is moderately thick and consists of a thicker and darker outer layer and a thinner and brighter inner layer.

At the periphery there is a distinct longitudinal edge or blunt keel. There is no distinct additional longitudinal ornament, although slight differences in the curvature of the flanks result in two very indistinct rounded edges on each flank with a very shallow furrow in between. Greatest width of spiral is near the umbilicus.

The transversal ornament consists of small near-parallel wrinkles. Some wrinkles are stronger, but they do not form peristomes. On the flanks the wrinkles are straight, they run obliquely backward towards the periphery, but near the periphery they are curved forward.

The material from SdB1 includes three specimens in moderate preservation (Pl. 2, Figs 3–4) and two fragments. These specimens are more damaged, smaller (SD of the largest specimen is 9.3 mm), somewhat thicker (SW of the thickest specimen is 2.8 mm), and most of them are very low trochospiral instead of planispiral. The periphery and the tube's surface are only partially preserved, but it is obvious that the keel or edge at the periphery is only weakly developed. The transversal wrinkles are identical to these of the specimen from SdB3. One specimen consists of 3½ whorls. One spiral is sinistral, two spirals dextral, and two others are too fragmentary preserved. In some specimens small remains of the non-spiral initial tube portions are visible; TL of the largest non-spiral initial tube portion is 2.0 mm and TD 0.8 mm.

Discussion: By its edge or keel and by its planispiral instead of trochospiral shape, the specimen from SdB3 resembles Eocene species of the genus *Rotularia* Defrance, 1827a sensu stricto, e. g. *Rotularia spirulaea* (Lamarck, 1818), more than Cretaceous *Rotulispira* species. In contrast, the specimens from SdB1 are thicker, very low trochospiral, and a longitudinal keel or edge is weakly developed or absent. However, these differences are interpreted as an intraspecific variability within only a single *Rotulispira* species, because a similar variability is also known within other *Rotulispira* and *Rotularia* species.

Genus *Metavermilia* Bush, 1904 emend. Zibrowius, 1971

Subgenus *Metavermilia* (*Vepreculina*) Regenhardt, 1961

***Metavermilia* (*Vepreculina*) *infracretacea* nov. spec.**

(Pl. 3, Figs 1–9)

Material: SdB1: 178 specimens (many individuals; NHMW 2010/0021/0020–0028, .../0091–0092). SdB2: 46 specimens (many individuals; NHMW 2010/0021/0093).

Derivatio nominis: After the occurrence in the Lower Cretaceous. Hitherto the subgenus was only described from the Upper Cretaceous.

Holotype: A tube with triangular cross-section forming an inward coiling loop fixed to the concave inner surface of a bivalve shell. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 3, Figs 7a–c, NHMW 2010/0021/0026.

Diagnosis: A species of the subgenus *Metavermilia* (*Vepreculina*) possessing one, three, five, seven or nine longitudinal ornaments. Peristomes are very common, they are strong but short and are annular or protruding on the upper side and at the base of the free tube portion. The tube has a strong tendency to form loops. Cross-section is usually either tunnel-shaped or triangular.

Description: Tube small, TD 0.2–1.7 mm. L of fragments circa 10 mm at maximum; tubes, however, originally had been much longer. The tubes increase only slowly in diameter and are fixed to a substrate for nearly all of their length. However, some fragments (L up to 3.3 mm) of the free tube portion are found (Pl. 3, Fig. 1). They angle away from the substrate at 20 to 45 degrees (Pl. 3, Fig. 3).

Often several or many very small tubes together encrust a large substrate, with the tubes arranged irregularly (Pl. 3, Fig. 5). However, sometimes only one or a few medium-sized tubes together are growing on a substrate. Tube strongly curved, in many specimens forming a loop of 1.5–4.0 mm LD consisting of only ½ – 1⅔ whorls (Pl. 3, Figs 2–4, 6–8). In a few tubes, additional earlier built irregular loops are situated underneath the upper main loop (Pl. 3, Fig. 3), so that the total number of whorls may be up to nearly 3. Often the loop is fixed to a substrate, but some loops were found isolated.

The most characteristic specimens possess five longitudinal ornamental elements, but many others have only one or three, and some have even seven or rarely nine. The longitudinal elements consist of rows of small granules or small keels with or without granules on top. In the tubes with triangular cross-section the median keel is much stronger developed than the lateral keels or rows.

Short but strong peristomes are very common and occur in irregular distances. Usually the peristomes are annular and situated perpendicular to the tube's longitudinal axis (Pl. 3, Figs 6, 9a), but less often they are curved and protrude at the median keel and, in the free tube portion, also at the base, resulting in a protruding spine in the fixed portion (Pl. 3, Fig. 4) and three spines in the free portion (Pl. 3, Fig. 1).

Some of the specimens are tunnel-shaped in cross-section (Pl. 3, Figs 3, 6 and 9) and relatively wide and low with a narrow or rarely wide seam. Others are triangular (Pl. 3, Figs 7–8) with either straight or slightly convex sides and relatively high. The cross-section of the free tube fragments is pentagonal, oval or circular (Pl. 3, Figs 1d, 3b). A fragment of the free tube portion (not figured, L 3.0 mm, D 1.5 mm at the peristomes) is slightly curved, oval (somewhat dorsoventrally compressed) in cross-section and has five small keels situated close to each other and seven annular peristomes. In general, annular peristomes are mainly found in tubes with tunnel-shaped or circular cross-section, whereas protruding peristomes are mainly found in tubes with triangular or pentagonal cross-section.

The tube wall is moderately thin, homogenous in some specimens, in others consisting of a thick dark outer layer and a bright thin inner layer. However, it cannot be excluded that the inner layer is a lithified crust formed by microbes and not part of the serpulid tube.

Discussion: By its small and only slowly increasing TD, by its longitudinal ornament often consisting of rows of granules and by its often annular peristomes, the present species is a typical representative of the subgenus *Vepreculina*. It is the geologically oldest hitherto described species of that subgenus. It differs from Late Cretaceous species by its stronger tendency to form curves and loops and to encrust a substrate by a large number of tubes.

In the SdB material, the tubes with triangular or pentagonal cross-section and with protruding peristomes forming spines resemble the genus *Plagostegus* PHILIPPI, 1844. However, despite the mentioned morphological features, a proper sorting into *Vepreculina*-like and *Plagostegus*-like tubes was not possible. Moreover, in the most typical specimens of the genus *Placostegus*, the peristome spines are longer, and the free tube portion angles away from the substrate nearly vertically.

Some small *Vepreculina* loops look similar to small spirorbin spirals, especially to *Pileolaria*? sp. 2. However, *Vepreculina* loops start with a non-spiral initial tube portion.

Those specimens in which several or many small tubes encrust a common substrate irregularly may resemble an early phase of colonization of the genus *Filograna* before arranging subparallel and before forming a vertical bundle of tubes. However, this similarity is only superficial, because the longitudinal ornaments and the common annular peristomes clearly indicate that the tubes belong to *Vepreculina*.

Genus *Filogranula* Langerhans, 1884 (non Brünnich Nielsen, 1931)

***Filogranula cincta* (Goldfuss, 1831)**
(Pl. 4, Fig. 1)

1831 *Serpula cincta* nobis. – Goldfuss: p. 237, Pl. 70, Figs 9a–c.
1983 *Filogranula cincta* (Goldfuss, 1831). – Jäger: pp. 68–71, Pl. 8, Figs 8–13. [cum syn.]
2005 *Filogranula cincta* (Goldfuss, 1831). – Jäger: p. 151, Pl. 2, Figs 10–13. [cum syn.]

Material: SdB1: One specimen (NHMW 2010/0021/0029).

Description: The fixed tube fragment is straight, wide and has three sharp keels. TL is 4.5 mm, TW 1.0 mm. The median keel is nearly straight and situated in a somewhat higher position, and the two lateral keels are undulated. There is no transversal ornament. The cross-section is trapezoidal, because the latera stand obliquely and form a seam at the base. The tube wall is moderately thick and appears to be homogenous.

Discussion: The present tube is very similar to the tubes of *Filogranula cincta* from the Late Cretaceous. In spite of the large difference in geological age there is no apparent morphological difference.

Occurrence: Lower Hauterivian to Upper Maastrichtian. In the Lower Cretaceous, the species is rare and restricted to a few shallow marine habitats, but it is widespread and common in marine habitats in the Upper Cretaceous.

***Filogranula*? *provencalis* nov. spec.**
(Pl. 4, Figs 2–5; Pl. 5, Figs 1–7; Pl. 6, Figs 1–6)

2007 *Propomatoceros* sp. – Moosleitner: Pl. 10, Fig. 7 (pars, as "*Protomatoceros*"), 11 (pars).
2007 *Mucroserpula* sp. – Moosleitner: Pl. 10, Figs 5–6, 13. [However, Fig. 6 is from a different locality, "Tonils"]
2007 ?*Propomatoceros* sp. – Moosleitner: Pl. 10, Figs 2, 8.
2007 *Placostegus* sp. – Moosleitner: Pl. 10, Fig. 14.

Material: SdB1: 235 specimens (274 individuals; NHMW 2010/0021/0030–0046, .../0094–0098). SdB2: 60 specimens (71 individuals; NHMW 2010/0021/0099–0102).

Derivatio nominis: After the Provence area in SE France. The present species was found at the Serre de Bleyton which is situated in the Provence.

Holotype: A free tube portion with two peristomes, in the posterior peristome the two lower spines protrude further forward than the other three spines. Longitudinal furrow on underside. TL 4.6 mm, TW including peristome 1.6 mm, TH 1.8 mm. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 6, Figs 1a–d, NHMW 2010/0021/0041.

Diagnosis: The tubes are moderate in size. In the fixed tube portion there are either one or three keels or longitudinal edges, in the free tube portion there are either three or, more often, five. They are rounded, not undulating, and may be indistinct. In the free portion, as well as rarely also in the anterior part of the fixed portion, peristomes with five strong protruding spines occur.

Description: Fixed (Pls 4–5, all Figs except Pl. 5, Fig. 7) and free tube portions (Pl. 6, all Figs except Fig. 3) exist. L of the longest fragments of the fixed tube portion is up to circa 25 mm, but originally they may have been longer. Fixed portions increase in TD at moderate rate. TW (measured at the tube base) is 0.4–2.4 mm, but usually 0.8–1.8 mm. The fixed tube portions are sometimes only slightly curved, more often strongly and irregularly curved (Pl. 5, Figs 2–3 and 6) or serpentine (Pl. 4, Fig. 2; Pl. 5, Figs 1a–c) or, most often, forming one or two irregular loops (Pl. 4, Figs 4–5; Pl. 5, Fig. 4). Loops in which the tube uses its own posterior portions as a substrate are often formed if the size of the original substrate is limited. Usually the loops consist of 1–1½ whorls, or 2⅓ whorls at maximum. In a few specimens, the loop forms a regular cone. In a few other specimens, the tube forms a loop of up to 1¾ whorls all around a more or less upright standing cylindrical substrate (Pl. 4, Fig. 3) in a manner similar to the genus *Dorsoserpula* PARSCH, 1956 sensu JÄGER, 2005, but less regular in shape. A basal seam of variable size making the tube either wide or high can be developed. In a single specimen, the tube base is attached at some small spots only by foot-like protuberances. More than 10 per cent of the specimens consist of two individuals (Pl. 6, Fig. 6), and a few consist of even up to five.

In some specimens the transition from the fixed to the free tube portion is preserved, and in a few of them also a short part of the free tube portion. At the transition, a pedestal may be formed by two pillars with a small cave in between. The free tube portion usually angles away from the substrate at 0 to 40 degrees, less often at 40 to 70 degrees, and in a single specimen even at 90 degrees.

A few isolated fragments of the free tube portion are found. They are straight or somewhat curved or slightly twisted like cork-screw. TL is 6.5 mm at maximum. TW increases only slowly (except at peristomes), TW is 0.9–1.6 mm outside peristomes and 1.4–2.0 mm at peristomes.

In the fixed tube portion there is a more or less distinct, rounded, median longitudinal edge or a rounded keel. If a keel is developed, it is normally neither high nor undulated.

During ontogeny the latera may change from straight to convex, and the keel may turn into a rounded edge. In many specimens the convexity of the latera may be stronger at a certain level and may thereby form two additional upper/lateral edges which can be indistinct or well-developed. Thus a variety with one keel or rounded edge (Pl. 4) and another variety with three keels or rounded edges (Pl. 5) can be discriminated, even though many transitional specimens with very weak lateral edges exist. In the fixed tube portion, approximately 40 per cent of the specimens are one-keeled and approximately 60 per cent three-keeled. The distance between the three upper edges or keels is smaller than their distance to the base. Often the upper side of the tube is convex or roof-shaped, so that the median edge or keel is situated at a higher level than the two upper/lateral edges or keels. Only in a single specimen (Pl. 6, Fig. 3b), a fourth keel is present at one of the two latera of the fixed tube portion for a short distance, and in another specimen the keel turns into a line-like groove anteriorly.

In the free tube portion, the edges of the former base form two additional longitudinal ornaments, so that in total either three or five rounded longitudinal edges or, less often, keels are present. At the base of the free tube portion, a narrow median longitudinal furrow (Pl. 6, Figs 1c and 5c) is present in some specimens but absent in others, and only in a single specimen a line-like furrow is present on each of the latera.

Incremental lines are seen in a few specimens (Pl. 6, Fig. 4b), especially when weathered. In the fixed portion, they are relatively strongly curved forward at the median edge or keel and usually less so at the base, but less often the situation is vice versa. In the three-keeled variety, they are either less curved forward at the upper/lateral edges or keels or even curved backward here. In the fixed tube portion, the curvature of the incremental lines causes a short and blunt spine protruding over the aperture (Pl. 4, Fig. 3c; Pl. 5, Fig. 5) and a somewhat less protruding base which may form a pedestal below the aperture. In the free tube portion, the incremental lines are curved forward toward the edges or keels.

Weak peristomes may rarely occur all along the tube. However, strong peristomes are restricted to the anteriormost tube portion. Strong peristomes are rare in the fixed tube portion (Pl. 6, Fig. 3 and also seen in a loop-forming specimen ¼ whorl posterior of the aperture). In contrast, nearly all of the longer fragments of the free tube portion found isolated possess at least one (15 specimens; e. g. Pl. 6, Figs 2–6) or even two strong peristomes (the holotype; Pl. 6, Fig. 1) at or, less often, just posterior of the aperture. Pl. 5, Fig. 7 is one of the few long fragments of the (possibly) free tube portion lacking a peristome.

Peristomes flaring, with TW gradually increasing towards the peristome, but abruptly decreasing anterior of the peristome, so that the anterior tube portion appears to grow out of the peristome funnel. At the peristomes, the keels form five strongly protruding, more or less long spines. In some specimens the upper median keel forms the longest spine (Pl. 6, Fig. 2), in others the two lower keels form the longest spines (Pl. 6, Fig. 1), whereas the two upper lateral keels never form the largest spines.

The cross-section of the one-keeled variety is tunnel-shaped to rounded triangular (Pl. 4, Figs 3a-b) in the fixed portion and triangular, but usually rounded with convex sides, or rounded subpentagonal (Pl. 4, Fig. 5a) in the free portion. The cross-section of the three-keeled variety is usually trapezoidal to rounded pentagonal (Pl. 5, Figs 1d and 2b) or, less often, subquadrate, or rarely triangular (Pl. 5, Fig. 3b) in the fixed portion and usually pentagonal in the free portion (Pl. 6, Figs 1–2 and 4–6). In many specimens the height of the cross-section is slightly larger than its width, but the ratio: TH to TW may vary considerably between specimens, often depending upon the seam which, if developed, may be either wide or high. In many specimens a longitudinal canal on either side of the tube base is visible (Pl. 5, Fig. 2b), but only a single tube may perhaps have a cellular construction of the base.

Usually the tube wall is moderately thick to very thick, especially at the peristomes (Pl. 6, Fig. 5c is an extreme example). On average, the tube wall is slightly thicker in the three-keeled than in the one-keeled variety. Rarely the tube wall is thin, especially in the small posterior tube portion.

Usually either the whole tube or at least the thick outer tube layer is bright grey, less often median grey, but some specimens are medium violet or dark violet.

In cross-section, the tube wall appears to be homogenous in most specimens, but in some others a thin, usually brighter, but rarely darker, inner layer is visible. In a single specimen, the bright innermost layer is surrounded by another thin but dark layer. Very rarely are the incremental lines of the parable lamellae visible in longitudinal section.

Discussion: The variety with one keel or rounded edge and the variety with three keels or rounded edges are not considered to represent two different species, because many transitional specimens with very weak lateral edges exist. Both varieties correspond in morphology apart from the number of keels or edges and apart from a slight difference in the thickness of the tube wall.

Moreover, the fragments of the fixed and those of the free tube portion are not considered to represent two different species either. Even though strong peristomes are very common in the free tube portion but very rare in the fixed tube portion, the fragments match very well in morphology (apart from the peristomes and from the tube base), in size, thickness of tube wall and colour. Also in living *Filogranula* species, peristomes may be much more common in the free than in the fixed tube portion.

The present species is affiliated to the genus *Filogranula* with a question mark. On the one hand, the free tube portion with its common peristomes possessing five spines resembles living representatives of *Filogranula* very much. On the other hand, the fixed tube portion is less characteristic and could belong to *Filogranula* as well as to other genera.

The present species is easily distinguished from most other SdB serpulids by its bright grey colour and by its rounded edges or keels.

Mucroserpula? *bleytonensis* nov. spec. has also three rounded keels, but these are always distinct, and the colour is brown or violet instead of bright grey.

The three-keeled variety differs from *Filogranula cincta* by its weaker and non-undulating keels, by the rarity of peristomes in the fixed tube portion and by its often very long and strongly protruding peristome spines. The peristomes of the present species resemble those of living *Filogranula* species and also those of *Serpula* (*Cementula*) and *Spiraserpula* more than those of the Cretaceous *Filogranula cincta*.

The three keels of the Jurassic *Filogranula runcinata* (J. de C. Sowerby, 1829) which was revised by Ippolitov (2007) are sharper, but otherwise this species is similar to the three-keeled variety of *Filogranula*? *provencalis*.

The one-keeled variety differs from the genus *Propomatoceros* Ware, 1975, for example from *Propomatoceros semicostatus* (Regenhardt, 1961) from the Barremian of Hildesheim, north Germany, by the fact that the edge or keel is usually rounded and by the rarity of peristomes in the fixed tube portion.

Serpulidae, gen. et sp. indet. 1
(Pl. 1, Fig. 8)

Material: SdB1: 6 specimens (NHMW 2010/0021/0082). SdB2: 1 specimen (NHMW 2010/0021/0008).

Description: Tube relatively large, fixed to a substrate for most of its length. It is either straight or curved or forms a loop or spiral. TD is usually 1.5–3.4 mm, but 6.0 mm in a single specimen. A small keel or longitudinal edge is present in some specimens but absent in others. Transversal ornament is lacking except for an annular constriction in one specimen. The tube wall is relatively thin.

Discussion: This somewhat heterogenous group includes moderately preserved, relatively large (compared to most other species from the SdB) and relatively thin-walled serpulid remains. Although the material is not sufficient for a detailed description and determination, it proves the existence of at least one more species in the SdB serpulid fauna.

The sparse ornament together with the relatively thin tube wall resembles *Parsimonia* Regenhardt, 1961 which, however, normally has even larger tubes.

Serpulidae, gen. et sp. indet. 2
(Pl. 1, Figs 9a-b)

Material: SdB1: One single specimen and perhaps another small fragment (NHMW 2010/0021/0009).

Description: The tube is somewhat curved and bright. L is 11.5 mm, TD 3.2 mm. The surface is corroded all around, thus there are nearly no traces preserved of possible ornament except for an indistinct shallow longitudinal furrow on the presumed underside. This furrow and the overall circular cross-section point to a fragment of the free tube portion. The present surface consisting of irregular shallow pits and sharp, narrow and deep near-transversal furrows is due to corrosion. The tube wall is moderately thick, and in cross-section many layers are visible.

A small fragment of a second large tube possibly belonging to the same species was used as a substrate by a specimen of *Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* (Pl. 9, Fig. 4).

Discussion: Although the specimen is a serpulid tube without any doubt, it is indeterminable. It cannot be interpreted to be a corroded specimen of one of the other taxa from the SdB described in the present paper. By its general shape and size, it resembles *Protula*? *antiquata* (J. DE C. SOWERBY, 1829), a species wide-spread and common in the Albian and Cenomanian.

Genus *Serpula* LINNAEUS, 1758

Subgenus *Serpula* (*Cementula*) REGENHARDT, 1961

***Serpula* (*Cementula*) sp.**

(Pl. 2, Figs 6–8)

Material: SdB1: 31 specimens (31 individuals; NHMW 2010/0021/0017–0019, .../0083). SdB2: 5 specimens (6 individuals; NHMW 2010/0021/0084).

Description: Tube small-sized, W is 0.3–1.3 mm. The tube grows only slowly in diameter. The fixed tube portion usually forms more or less regular spirals. SD is 6.0 mm at maximum. A spiral consists of up to 4⅛ whorls. The spirals are more or less plain, even though some are deformed due to the uneven substrate. Most spirals are umbilicated (Pl. 2, Fig. 6a), but some are not. A tube may consist of up to three spirals. Straight, curved or rarely loop-forming non-spiral tube portions may connect the spirals or/and are situated before or/and after the spirals. In the specimens consisting of two or three spirals, the spirals usually partly overlap one another (Pl. 2, Fig. 6). In a few other specimens, the spirals do not touch each other but are connected by a non-spiral tube portion. In most cases the sense of coiling changes from one spiral to the following.

As is usual in *Serpula* (*Cementula*), a well-developed seam widens the tube base and "melts" the whorls of the spirals together, but nevertheless the whorls are still detectable as rounded bulges (Pl. 2, Figs 6–7).

The anteriormost tube portion of the latest spiral may become somewhat flattened, resulting either in two rounded longitudinal edges at the upper left and right or in a low keel or in three low keels (Pl. 2, Figs 6a–b). Only rarely an "ala" which is the sort of peristome characteristic of *Serpula* (*Cementula*) REGENHARDT and also of *Spiraserpula* REGENHARDT is seen. Rarely the spiral is followed by a short free tube portion (Pl. 2, Fig. 7), which possesses a low keel.

Moreover, a single broken off free tube portion is found (Pl. 2, Fig. 8), TL is 4.0 mm, TD at peristomes 1.5 mm, TD between peristomes 0.8 mm. It has five peristomes, four of these are arranged as pairs. Each peristome shows the usual "ala" aspect when seen from above, is rounded triangular in cross-section and has three spines. However, between the peristomes the cross-section of the tube is not triangular, but circular, and has no keels.

Most specimens are dark violet, except those which are strongly corroded.

Discussion: According to JÄGER & SCHNEIDER (2009), *Cementula* is here formally considered as a subgenus of the genus *Serpula*. In outer morphology the tubes of *Serpula* (*Cementula*) are very similar to those of *Spiraserpula*, but the decisive difference is that *Spiraserpula* possesses internal tube structures ("its", see PILLAI 1993 and PILLAI & TEN HOVE 1994) whereas *Serpula* (*Cementula*) lacks them. Not a single "its" was detected in the SdB specimens, therefore they very probably belong to *Serpula* (*Cementula*) which is not surprising, because "its" and *Spiraserpula* are known with certainty only from the Campanian onwards. However, a little uncertainty remains, because "its" are not always clearly visible and the number of specimens is limited.

By their small size, flatness of the spirals and the sparseness of ornament the SdB specimens resemble the representatives of *Serpula* (*Cementula*) from the Lower and Middle Jurassic more than those of *Serpula* (*Cementula*) from the Upper Jurassic and *Spiraserpula* from the Upper Cretaceous.

By its rounded triangular, three-spined peristomes, the fragment of the free tube portion (Pl. 2, Fig. 8) resembles the free tube portion of several species of the genus *Placostegus* PHILIPPI, 1844. However, in contrast to *Placostegus*, the tube is circular between the peristomes and has no keels.

Genus *Mucroserpula* REGENHARDT, 1961

***Mucroserpula pentaditrupoidea* nov. spec.**

(Pl. 7, Figs 1–3)

M a t e r i a l: SdB1: 11 specimens (NHMW 2010/0021/0047–0049, .../0103).

D e r i v a t i o n o m i n i s: Although the present species is affiliated to the genus *Mucroserpula*, it resembles the genus *Pentaditrupa* REGENHARDT, 1961.

H o l o t y p e: Fragment of free tube portion with three distinct upper und upper lateral keels and two rounded lower edges. TL is 7.7 mm, TD is 3.5 mm. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 7, Figs 1a–c, NHMW 2010/0021/0047.

D i a g n o s i s: Following the fixed tube portion, the long free tube portion is either elevated or clinging closely but loosely to a substrate. Five longitudinal ornaments are situated in nearly equal distance from each other, resulting in a pentagonal cross-section. Often the three upper ornaments are developed as keels and more distinct than the two lower ones. The tube wall is thinner than in the similar genus *Pentaditrupa* and usually appears to be more or less homogenous.

Description: The tube fragments are either straight or curved. Two show torsion around their longitudinal axis, and one of these is twisted like a fragment of a cork-screw. The tubes increase moderately fast in diameter. One specimen is firmly fixed to a rigid substrate, but some others, including the cork-screw shaped one, show traces on the underside of formerly closely clinging to a substrate which is no longer preserved. Maximum sizes of the fragments: L 10 mm, D 3.8 mm, H 4 mm.

There are five longitudinal ornaments. In a few specimens, all five are developed as somewhat rounded but distinct keels, but in most specimens only the three upper ornaments, especially the upper central one, are keels, whereas the two lower ornaments are much rounded longitudinal edges (Pl. 7, Figs 1–2). In one specimen, there are even four rounded edges on the underside and on one of the latera, presumably due to irregularities of the former substrate. In most specimens, the five ornaments are situated in a nearly equal distance from each other, so that the overall aspect in cross-section is more or less pentagonal resembling the genus *Pentaditrupa*. There may be some irregular longitudinal concavities between the keels. Some specimens are higher than wide (Pl. 7, Fig. 3), but in another one the base is relatively wide, so that the cross-section is trapezoidal and the upper lateral keels are closer to the lower keels than the three upper keels are to each other.

There are no peristomes. However, some specimens, especially those which are a bit corroded, show incremental lines standing close to each other. These are moderately curved forward at the uppermost central keel, moderately to slightly curved forward at the two upper lateral keels and slightly or not at all curved forward at the two lower keels. The curvature differs within and between specimens. In a single specimen the aperture is preserved (Pl. 7, Fig. 3). Here the weak curvature of the incremental lines results in five low and rounded knobs at the aperture. At the aperture, the tube diameter diminishes only slightly and only at the anteriormost end of the tube. In principle, this is a weakly developed "*Ditrupa* aperture".

The tube wall is moderately thick. Usually the tube wall appears to be homogenous in cross-section, and there is no thin bright inner layer. However, in one cross-section a slightly thicker and slightly darker outer tube layer and a slightly thinner and slightly brighter inner tube layer can be distinguished, but this difference is presumably only caused by a strong incremental line which separates two areas of slightly different colour. In another cross-section, the tube wall seems to be composed of two layers of equal thickness and colour. All specimens are somewhat brownish dark violet.

Discussion: The genus *Mucroserpula* characterised by small to moderate size and three longitudinal ornaments on the upper side is wide-spread and common in the Jurassic and Lower Cretaceous.

The present *Mucroserpula* species resembles Lower Jurassic representatives (less so Upper Cretaceous representatives) of the genus *Pentaditrupa*. It combines features of both genera, thus representing neither a typical *Mucroserpula* nor a typical *Pentaditrupa*.

Although the pentaradiate arrangement of the five keels or edges, the rareness of a rigid fixation to a substrate and the absence of peristomes resemble the genus *Pentaditrupa*, it was decided not to affiliate the present species to that genus for a number of reasons (see below). The situation resembles somewhat of that in the Upper Sinemurian and Pliensbachian, where *Mucroserpula*-like and *Pentaditrupa*-like tubes occur together, as well, and are not always easily distinguished.

In detail, the present species differs from *Pentaditrupa* considerably: In some specimens the three upper keels are distinctly stronger than the two lower edges. This difference is stronger marked here than in *Pentaditrupa*. The close clinging to a (not preserved) substrate instead of either being firmly fixed or being free is characteristic neither of *Pentaditrupa* whose Upper Cretaceous representatives are free for all of their preserved length and whose Lower Jurassic representatives are free for most of their length nor of *Mucroserpula* which is usually firmly fixed at least for most of its length. The present tube fragments appear to have increased faster in diameter than in *Pentaditrupa*, and the gentle and regular curvature of the Cretaceous representatives of *Pentaditrupa* is lacking. The tube wall is somewhat thinner than in *Pentaditrupa* and lacks the very thin bright inner layer which is so characteristic for at least the Cretaceous representatives of *Pentaditrupa*, especially *P. subtorquata* (Münster in Goldfuss, 1831).

Moreover, *Pentaditrupa* is a soft-bottom dweller in calm offshore waters, whereas the tubes of *Mucroserpula pentaditrupoidea* are derived from shelly shallow marine facies.

The somewhat brownish dark violet colour combined with the relatively large size makes the present species easily distinguished from most other species from the SdB. For discrimination from *Neomicrorbis barremiensis* nov. spec. see discussion of that species.

***Mucroserpula*? *bleytonensis* nov. spec.**
(Pl. 7, Figs 4–7)

Material: SdB1: 33 specimens (33 individuals; NHMW 2010/0021/0050–0052, .../0104). SdB2: 6 specimens (10 individuals; NHMW 2010/0021/0053, .../0105–0106).

Derivatio nominis: After the site "Serre de Bleyton" in France where the specimens were collected.

Holotype: At least four curved or serpentine tubes are crowded together on an oyster shell, total sizes: L 11.0 mm, W 7.4 mm, H 7.4 mm. The holotype has a straight anterior portion and a curved posterior portion, the three keels are equal in size, a short free tube portion angles away from the substrate at 20 degrees. Sizes of holotype: visible TL circa 6.0 mm, TW 2.0 mm, TH 2.7 mm, TL of free portion 0.8 mm. Barremian, SdB2, Serre de Bleyton, Drôme, France, Pl. 7, Figs 7a–d, NHMW 2010/0021/0053.

Diagnosis: Tube curved, often forming a loop or a spiral. Three strong, wide and rounded keels in the centre and on the edges of the upper side, keels either more or less equal to each other or median keel wider and lower. Cross-section of tube rounded rectangular.

Description: Tube medium-sized (TD normally 2.0–3.5 mm), increasing in diameter at moderate rate, fixed for the greatest portion of its length, curved, serpentine, often forming a loop or a spiral (Pl. 7, Figs 4–6). LD or SD is 4.0–10.0 mm. If a spiral or a spiral-like loop is formed, the aspect may be very similar to that of a large spirorbin tube, but a non-spiral initial tube portion is seen at least in some specimens (in the specimen on Pl. 7, Fig. 6 it is preserved, but not visible in the photograph, it is slightly curved, TL 2.0 mm, TD 0.8 mm). Most but not all curves, loops and spirals are sinistral. There is a tendency towards gregarious settlement of the larvae, because one specimen is a cluster of at least four individuals (including the holotype) densely crowded on an oyster shell (Pl. 7, Fig. 7).

The most prominent feature are the three strong, wide and rounded, more or less straight, not undulated keels situated in the centre and on the edges of the upper side where they may project laterally. The keels are either more or less equal to each other (Pl. 7, Figs 5 and 7), or the median keel is wider and sometimes lower (Pl. 7, Figs 4 and 6). There are no peristomes. Transversal incremental wrinkles may be present, and some incisions and bulges may occur in some of the keels.

A short (TL up to 1.0 mm) free portion is present in most of the specimens (Pl. 7, Figs 5–7). It angles away from the substrate at 20 to 70 degrees and sometimes has a median furrow on the underside (Pl. 7, Figs 7c–d). Moreover, an isolated fragment of a free tube portion was found.

The cross-section is rounded rectangular. It may be slightly trapezoidal if a narrow basal seam is present. TH and TW are either more or less equal, or TH is larger than TW (Pl. 7, Figs 7c–d). The tube wall is moderately thin to moderately thick. Usually the tube wall appears to be homogenous, but rarely a very thin brighter inner layer may be distinguished. The colour is brown or violet.

Two tubes from SdB2 are infested by the symbiont *Protulophila gestroi* ROVERETO, 1901.

Discussion: In spite of the spirorbin-like loops or spirals, the presence of a non-spiral initial tube portion shows that the present species is not a spirorbin.

Among Jurassic and Upper Cretaceous serpulids, several *Mucroserpula* species resemble the present species, but they differ by the facts that their keels are usually narrower and sharper and that their median keel is usually elevated above the lateral keels. For these reasons, the present species is affiliated to *Mucroserpula* with a question mark only.

Among living serpulids, some species of the group around the genus *Serpula* LINNAEUS, 1758, especially *Serpula* itself, resemble the present species by their tendency to form loops and by having three distinct keels on the upper side, e. g. *Serpula oshimae* IMAJIMA & TEN HOVE, 1984 which before had been figured as *Serpula* cf. *kaempferi* by IMAJIMA (1978).

Genus *Pyrgopolon* DE MONTFORT, 1808

Subgenus *Pyrgopolon* (*Pyrgopolon*) DE MONTFORT, 1808

***Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* nov. spec.**
(Pl. 8, Figs 1–5; Pl. 9, Figs 1–4)

Material: SdB1: 36 specimens (42 individuals; NHMW 2010/0021/0054–0057, .../0059, .../0061–0062, .../0107). SdB2: 11 specimens (12 individuals; NHMW 2010/0021/0058, .../0060, ../0108–0109).

Derivatio nominis: In honour of GERO MOOSLEITNER, who discovered the sites at the Serre de Bleyton, collected and washed the fossils and forwarded them to palaeontologists.

Holotype: Fragment of a three-keeled fixed and seven-keeled free tube, TL 7.5 mm, TW 3.0 mm, total H 4.0 mm, TH of anterior cross-section 3.5 mm. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 8, Figs 2a–e, NHMW 2010/0021/0055.

Diagnosis: Tube moderately large. The median keel or comb is very prominent and protruding, forming a spine over the aperture. In total there are three longitudinal ornaments in the fixed and three, five or seven in the free tube portion. A separate inner tube layer is present.

Description: Tube medium sized. Maximum sizes of fragments: TL c. 33 mm (coiled to a loop of 11 mm LD), TL of free tube portion 7.5 mm, TW 4.0 mm, TH 4.4 mm. Tube consists of an irregularly curved, sometimes loop-forming fixed portion increasing fast in diameter and of a less curved or straight free portion increasing slowly in diameter and angles away from the substrate at 20 to 50 degrees. Underneath the beginning of the free tube portion a pedestal may be formed by two pillars with a small cave in between (Pl. 8, Fig. 2d), just as in Upper Cretaceous species. In one specimen (Pl. 8, Fig. 5), the tube forms a loop all around an upright standing bryozoan colony in a manner very similar to the genus *Dorsoserpula* PARSCH, 1956 sensu JÄGER (2005).

There is a prominent, high (e. g. Pl. 8, Figs 3a, 3c and 4a) and wide (e. g. Pl. 8, Figs 2a and 2e) median keel or comb, whose upper side is usually rounded (e. g. Pl. 8, Figs 2a, 2e, 4a, 4c and 5b), except for one specimen with a sharp keel. Very rarely the keel can be undulating. According to the protruding incremental lines which often produce a chevron-shaped pattern on the median keel or comb, this keel or comb forms a large spine protruding over the aperture (e. g. Pl. 8, Figs 3b–c, 5a; Pl. 9, Fig. 1b). There are always two upper lateral keels or edges. These vary extremely. In some specimens they are nearly as prominent as the median keel and strongly developed (e. g. Pl. 8, Figs 2a und 3a), in others they are much weaker, sometimes forming only rounded edges (e. g. Pl. 8, Fig. 1a; Pl. 9, Fig. 3b). The three ornaments hitherto described are present in the fixed as well as in the free tube portion. In the free portion, either no (in some specimens, e. g. Pl. 9, Figs 1b–c), or two (in most specimens, e. g. Pl. 9, Fig. 3), or four (in a few specimens, e. g. Pl. 8, Figs 2–3) additional longitudinal ornaments are developed below the three described above. These are never very prominent, but either forming small but sharp keels or rounded edges. There are intermediates between the five-keeled and seven-keeled state because the two lowermost elements are sometimes developed as only very indistinct rounded edges. In total, the free tube portion has either three, five or seven longitudinal ornaments. There may be a longitudinal furrow in the centre of the underside of the free portion (Pl. 8, Fig. 3d).

The incremental lines are strongly curved forward at the median keel or comb. Otherwise they run perpendicular to the tube's longitudinal axis except at the underside, where they may be somewhat curved forward to form a small pedestal at the anterior end of the fixed tube portion, or they may be slightly curved backward at the underside of the free tube portion. Some of the fixed tube portions show regular but weak transversal ribs which are somewhat curved forward at the keel and at the base. There are no peristomes.

The cross-section is rounded polygonal according to the number and strong or weak development of keels or edges. Some specimens of the fixed tube portion are triangular with in part slightly convex sides, and only these specimens have a wide seam at the base (Pl. 8, Fig. 1a, Pl. 9, Fig. 2). The thickness of the tube wall may vary considerably; usually it is moderately thick, but relatively thin in a few specimens (Pl. 9, Figs 1 and 3).

In most specimens, a thick bright outer layer and a very much thinner dark inner layer can be distinguished. If the specimen is a bit weathered, the inner tube layer may be a little separated from the outer layer (e. g. Pl. 9, Fig. 4), similar to the situation in Upper Cretaceous species of the subgenus *Pyrgopolon* (*Pyrgopolon*). When weathered, a thin median slit may be visible in the cross-section of the median keel or comb (e. g. Pl. 8, Fig. 4a). A few specimens indistinctly show a cellular construction of the tube base, and a single specimen shows a leafy tube structure at the base but no arrangement in two longitudinal rows of cells. No tabulae are seen. The tube is bright grey or yellowish.

Discussion: The present species represents the probably geologically oldest representative of the genus *Pyrgopolon*. From the outer morphology, this species resembles the subgenera *P*. (*Pyrgopolon*) and *P*. (*Septenaria*), each of them is characterised by a different set of special features of the tube structure. Two special features of *P*. (*Pyrgopolon*), but none of *P*. (*Septenaria*), are detectable in some of the SdB specimens, although only indistinct. One special feature is that at least in some weathered specimens the thin inner tube layer is a little separated from the outer layer. The other special feature, the cellular construction of the tube base forming two longitudinal rows of cells, is only indistinctly seen in a few SdB specimens, whereas in another specimen the underside shows a leafy tube structure but no arrangement in two longitudinal rows. The only indistinct and only occasional presence of the special features is the reason why the subgenus name stands with a question mark. Presumably, in phylogeny the characteristic features only arose slowly and were not well developed in the earliest representatives of the genus and subgenus.

While the five- and seven-keeled specimens of the free tube portion resemble the tubes of Upper Cretaceous *Pyrgopolon* species very well and leave no doubt about the genus, the three-keeled fixed and free tube portions may resemble the genus *Mucroserpula*.

Some specimens of the present species form a loop in the fixed tube portion, whereas most species of the genus *Pyrgopolon* do not form a loop except for, e. g., *Pyrgopolon* (*Septenaria*) *voigti* Jäger (2005).

Genus *Pseudomicrorbis* nov. gen.

Type species: *Pseudomicrorbis pseudomicrorbis* nov. spec.

Derivatio nominis: Abbreviated combination of the term "pseudo" (from Greek Ψευδής, "lying, false") and the valid genus name *Neomicrorbis* Rovereto, 1903. The type species at first sight looks like a representative of that genus, but differs by possessing a non-spiral initial tube portion.

Diagnosis: After a non-spiral initial tube portion and after forming a loop, the adult tube forms a spirorbin-like spiral in most specimens. Sinistral and dextral spirals are nearly equally common. The longitudinal ornament consists of rows of small pits.

Discussion: See discussion of *Pseudomicrorbis pseudomicrorbis* nov. spec.

***Pseudomicrorbis pseudomicrorbis* nov. spec.**
(Pl. 9, Figs 5–9)

2007 *Neomicrorbis* n. sp. 2. – Moosleitner: Pl. 10, Fig. 16.

Material: SdB1: 56 specimens (84 individuals; NHMW 2010/0021/0063–0067, .../0110). SdB2: 12 specimens (18 individuals; NHMW 2010/0021/0111).

Derivatio nominis: Same as genus, see above.

Holotype: A dextral loop/spiral of 1⅔ whorls with a near-straight initial tube portion (not visible in the figures) and with 14 longitudinal rows of pits; SD 3.7 mm, TD 1.4 mm. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 9, Figs 6a–b, NHMW 2010/0021/0064.

Diagnosis: The ornament forms a very regular reticulate pattern consisting of usually 10–14 (occasionally less) longitudinal (= spiral) rows of tiny rectangular pits.

Description: This species starts with an initial tube portion (Pl. 9, Figs 5a–b, 9b) which is up to 6 mm long and usually curved or less often straight or somewhat serpentine. Remains can often be detected beside and underneath the main tube portion.

The initial tube portion is usually followed by one or sometimes more than one irregular compact loop and in most specimens at last by a perfect spiral which covers the loop(s) so that at first glace the aspect resembles a large spirorbin tube very much. The transition from the loop to the spiral is often gradual. However, in some specimens the tube forms neither a loop nor a spiral, but is only curved like a hook, or rarely it is nearly straight. In many specimens the aperture or at least a part of it is situated upon the foregoing whorl and directs obliquely upward. The aperture may slightly detach at last, and rarely an up to 0.8 mm long remnant of the free portion growing obliquely upward is present.

The tube increases moderately fast in diameter reaching a final D of 0.6–1.9 mm, usually 0.8–1.5 mm. Usually the regular spiral portion consists of 1–1¾ whorls, but in some cases less than 1 or up to 2¼ whorls, and in one case even of 4 whorls. SD is usually 2.0–4.0 mm or sometimes 1.0–5.0 mm. In 86 individuals the sense of coiling of the spiral or at least of the latest loop can be detected. 37 specimens are sinistral and 49 dextral. In the last whorl, be it wide or narrow, an umbilicus is present.

The present species shows a tendency towards gregarious settlement of the larvae. Up to eight tubes are present in a specimen.

The most characteristic feature is the unusual ornament forming a very regular reticulate pattern with very conspicuous tiny rectangular pits in-between (best seen in Pl. 9, Figs 6a–b, 7 and 8a–c). The pits are no holes, but are only present in the outer third of the tube wall. Usually there are 10–14 longitudinal (= spiral) rows of pits, but in three unusual specimens not identified with certainty there are only 4, 7 and, respectively, 8, rows. In longitudinal as well as in transversal direction the tiny pits are arranged in regular straight or very gently curved rows. There is neither a ramification nor an in-between insertion of additional lines, but it seems that during growth additional longitudinal rows of pits are inserted at the umbilicus and then gently ascend from the umbilicus by a low inclination. Only when the tube is somewhat weathered, the longitudinal rows of pits form small longitudinal furrows with small longitudinal keels in-between. This means that the transversal elements of the reticulate ornament are less resistant against weathering than the longitudinal elements.

One specimen forming a dextral loop has only four longitudinal keels which cease in the anterior tube portion, but there are three peristomes in the anteriormost quarter whorl instead. Only few other specimens possess short and sharp, flaring peristomes which protrude towards the tube base (Pl. 9, Figs 8a and 8c).

In cross-section the tube is rounded, thick-walled and, apart from the pits, usually appears to be homogenous except in a few specimens which show a thick and darker outer layer and a thin and brighter inner layer. In some specimens the aperture, though badly preserved, seems to be funnel-shaped, thus pointing indirectly to a well-developed inner ramus of the parable layer. Non-weathered specimens are usually dark violet or brown, weathered specimens are somewhat brighter.

Discussion: The presence of a well developed and sometimes rather long non-spiral initial tube portion clearly states that the present species is a non-spirorbin serpulid. Also the nearly equally common presence of sinistral and dextral tubes provides a strong clue against spirorbins of which most taxa (except the genus *Neomicrorbis*) show a rather constant sense of coiling.

Still, at first sight, the present species strikingly resembles a spirorbin, because in most specimens the anteriormost tube portion forms a perfect spiral. The spiral shape, together with the presence of sinistral and dextral spirals and a size larger than in most spirorbins match the tubes of the genus *Neomicrorbis* nearly perfectly. Moreover, the pattern of pits very much resembles the pattern of granules of the Upper Cretaceous *Neomicrorbis crenatostriatus crenatostriatus* (Münster in Goldfuss, 1831), even though, of course, the pits are depressions and the granules are elevations.

Also "*Spirorbis*" *clathratus* Étallon sensu Alth, 1882 from near the Jurassic/Cretaceous boundary of Galicia looks similar to the present species. However, the depressions within the reticulate pattern are presumably not developed as deep pits, and from the description and figures there is no evidence of a non-spiral initial tube portion.

The rows of pits resemble those of another, although smaller spirorbin, the living and fossil subgenus *Janua* (*Dexiospira*) Caullary & Mesnil, 1897, syn. *Neodexiospira* Pillai, 1970, see Jäger (1993, 2005), and also those of the living serpulin species *Pseudovermilia fuscostriata* ten Hove, 1975 and *P. multispinosa* (Monro, 1933), see ten Hove (1975, Pl. 8). However, these two *Pseudovermilia* species possess strong keels.

The reticulate pattern of pits together with the tendency to form loops and spirals resembles some vermetid gastropods, and the tube structure is not well preserved to provide a decision. However, in vermetid gastropods the most regular spirals are formed in the juvenile shell portion, whereas in the present serpulid species a regular spiral is only formed in the fully grown state.

Other loop- or spiral-forming serpulids, e. g. the genus *Placostegus*, differ by lacking pits and by possessing keels.

Subfamily Spirorbinae Chamberlin, 1919

Genus *Neomicrorbis* Rovereto, 1903

***Neomicrorbis barremiensis* nov. spec.**
(Pl. 10, Figs 1–4)

pars 2007 *Neomicrorbis* n. sp. 1 aff. *Neomicrorbis crenatostriatus subrugosus* (Münster in Goldfuss). – Moosleitner: Pl. 10, Fig. 9, non Fig. 10.

Material: SdB1: 52 specimens (59 individuals; NHMW 2010/0021/0069–0072, .../0112). SdB2: 5 specimens (5 individuals; NHMW 2010/0021/0113).

Derivatio nominis: Named after the occurrence in the Barremian stage.

Holotype: A sinistral spiral of three whorls, the underside formerly fixed to an unknown substrate shows spiral initial tube portion. A 1 mm long free tube portion angles away from the substrate at 40 degrees. Total D 5.3 mm, TD 1.6 mm, total H 1.9 mm. Barremian, SdB1, Serre de Bleyton, Drôme, France, Pl. 10, Figs 1a–c, NHMW 2010/0021/0069.

Diagnosis: A *Neomicrorbis* species increasing relatively fast in tube diameter and possessing no conspicuous ornament except for flaring peristomes. Usually the tube wall is moderately to very thick.

Description: A non-spiral initial tube portion is not developed, except in a single questionable specimen which forms a one-whorled loop instead of a spiral. Instead, the tube normally starts with a more or less regularly developed spiral (Pl. 10, Fig. 1c) consisting of up to 3 whorls and reaching a SD of usually 2.0–4.8 mm, but only 1.6 mm in one specimen. The spiral is or was fixed to a substrate which is not preserved in many specimens. In 58 specimens the sense of coiling can be determined: 31 are sinistral (Pl. 10, Fig. 1) and 27 dextral (Pl. 10, Figs 2–4). Sometimes two and in one case six tubes are present in a specimen. The umbilicus varies considerably from wide to narrow, and in a few specimens it is closed. At the end of the spiral, TD is 0.7–2.5 mm. In most specimens the compact spiral is followed immediately by the free tube portion, but in some specimens the tube may loose contact to the previous whorl, although the tube stayed fixed to the substrate for a few millimetres more, before finally the free tube portion begins, a growth pattern similar to that in *Neomicrorbis parietalis jagti* JÄGER, 1993 from the Danian.

Usually the free tube portion (e. g. Pl. 10, Fig. 2) angles away from the substrate at 30 to 50 degrees (range: 0 to 100 degrees). It is straight or somewhat curved, continuing the curvature of the spiral. Curved specimens of the free portion may form up to $^{1}/_{3}$ whorl. L of free portion is usually up to 4 mm, but may reach up to 6 mm. In the free portion TD is usually 1.6–2.3 mm, but only 1.1–1.2 mm in a few untypical specimens.

There is no distinct and regular longitudinal ornament, but some specimens have indistinct and non-continuous rounded edges in different numbers and positions. If present, they are mostly positioned on the upper left and the upper right. Up to five edges may be present, but usually there are less or none. Rarely a narrow but distinct longitudinal furrow is present on the underside of the free tube portion.

In many specimens 1–4 flaring peristomes (e. g. Pl. 10, Fig. 3) are developed in the anteriormost half whorl of the spiral or/and in the free portion. Flaring varies from slight to moderately strong. Moreover, some specimens show a fine but unspecific pattern of incremental lines.

The cross-section of the tube is rounded but usually not perfect circular, depending on the number and positions of the rounded longitudinal edges. The tube wall is thin in rare cases, but usually moderate to thick, and in some specimens extraordinarily thick. Although normally no tube structure is visible, it is concluded from the flaring peristomes that the inner ramus of the parable layer must be very well developed. Sometimes an innermost tube layer protrudes slightly out of the aperture (Pl. 10, Figs 3b–c). In one specimen, this innermost tube layer is brighter than the dark thick outer layer. However, normally the colour of the tube is uniform throughout, usually dark brownish violet, but brighter violet in a few specimens.

Discussion: The absence of a non-spiral initial tube part (except in one questionable specimen) is clearly different from the situation in *Pseudomicrorbis pseudomicrorbis* and strongly points to a spirorbin serpulid. Within the spirorbin serpulids, the relatively large size when compared to the size of most extant spirorbin species in combination with a near-equal frequency of sinistral and dextral specimens clearly points to the genus *Neomicrorbis*.

Although the existence of the genus *Neomicrorbis* already in the Jurassic and Lower Cretaceous had been briefly mentioned earlier (Jäger 2005, p. 196, since Late Bathonian; Ippolitov 2010, p. 201, since Middle/Late Jurassic), the present species is the first *Neomicrorbis* from the Lower Cretaceous described in detail.

By the lack of strong and regular longitudinal (spiral) ornament the present species resembles the Upper Cretaceous *Neomicrorbis crenatostriatus subrugosus* (Münster in Goldfuss, 1831). However, usually *N. c. subrugosus* is a bit thinner-walled and has not quite so strong peristomes.

By the prevailing dark brownish violet colour and by the occasional presence of rounded longitudinal edges, it may be argued that *Mucroserpula pentaditrupoidea* described above may represent the non-spiral anterior tube portion of the present species. However, these are definitely two different genera and species for the following reasons: *Mucroserpula pentaditrupoidea* grows distinctly larger in tube diameter. The rounded longitudinal edges of *Neomicrorbis barremiensis*, if present at all, are always weaker and much less regularly developed compared to *Mucroserpula pentaditrupoidea*. A connection of typically developed tube portions of both taxa has not been observed. *Mucroserpula pentaditrupoidea* possesses no flaring peristomes. The tube structures are different in both taxa.

Only one specimen was originally fixed to a no longer preserved cylindrical, maybe phytal object of 1 mm diameter or a bit larger. This is in contrast to *Neomicrorbis* and other serpulids from the Campanian and Maastrichtian which often had been fixed to such small cylindrical, presumably phytal objects.

Genus *Pileolaria* Claparède, 1868

Remarks: The SdB material includes many small spiral tubes. Most of them lack ornament and are described below as "Spirorbinae, gen. et sp. indet." Similar small spiral tubes which, however, show longitudinal ornament, are much less common. They indicate that, beside the more common and better defined taxa described in the other chapters, several additional but rare spirorbin species are present in the SdB fauna, even though some specimens may turn out to be only unusual specimens of the common taxa or even loops of non-spirorbin serpulids.

According to their sense of coiling, the small spirals possessing longitudinal ornament are separated into *Pileolaria*? and *Janua*? (*Dexiospira*?), even though affiliation to a genus is highly tentative.

***Pileolaria*? sp. 1**
(Pl. 10, Fig. 5)

Material: SdB1: 9 specimens (NHMW 2010/0021/0114). SdB2: 2 specimens (NHMW 2010/0021/0073).

Description: These specimens represent a small and rather heterogeneous assemblage of sinistral spiral tubes. Most are more or less planar, but some are winding upwards. The width of the umbilicus varies considerably between specimens. SD is 1.4–3.5 mm, TD 0.6–1.5 mm. All possess 3–6 keels, most of them 3 or 5. The keels are weakly to moderately developed. Usually the tubes are violet, but one is bright grey and another is yellow.

Among the best preserved specimens is a planar spiral fixed by a well-developed seam to an oyster shell from SdB2 (Pl. 10, Fig. 5). SD is 2.7 mm, TD 1.0 mm. There are five small, inconspicuous keels, three of them on the planar upper side and two close to each other on the outer latus, and fine incremental lines, but no peristomes.

Discussion: Although it is hardly possible to affiliate a Mesozoic spirorbin tube to a certain genus if no operculum is present (except if it is a *Neomicrorbis*), the sense of coiling and the number of keels suggest an attribution to *Pileolaria.*

***Pileolaria*? sp. 2**
(Pl. 10, Figs 6–7)

Material: SdB1: 4 specimens (2010/0021/0074, .../0115). SdB2: 1 specimen (NHMW 2010/0021/0116).

Description: The small sinistral tubes were originally fixed to substrates no longer preserved. In two of them the substrate was either uneven or had tilted during growth so that the spirals are a bit irregular. They do not tend to grow upward, and they do not have a free tube portion. They have a wide umbilicus and are yellowish brown. SD 1.1–2.0 mm, respectively, TD 0.3–0.7 mm. The two largest spirals are composed of 3⅔ and 3½ whorls.

The longitudinal ornament consists of 6–7 and in the smallest specimen even 9 small and low but nevertheless well visible line-like keels distributed rather evenly over the free surface in the largest and small specimens but restricted to approximately the upper half of the tube in the medium-sized specimen. There is no transversal ornament.

Discussion: By their small size, uniform shape, uniform sense of coiling, unusual high number of keels and uniform colour, these specimens certainly represent a separate spirorbin species. However, as already mentioned above, affiliation to a certain genus is hardly possible. This is even more true for the present species because of the unusual high number of keels. Its affiliation to *Pileolaria* is tentative at best.

The present species differs from *Pileolaria*? sp. 1 by its small TD and SD and by its higher number of keels.

Genus *Janua* Saint-Joseph, 1894

Subgenus *Janua* (*Dexiospira*) Caullery & Mesnil, 1897

***Janua*? (*Dexiospira*?) sp.**

(Pl. 9; Fig. 10)

Material: SdB1: 10 specimens (NHMW 2010/0021/0068, .../0117).

Description: These specimens represent a small and rather heterogeneous assemblage of dextral spiral tubes. Nearly all are more or less planar, but there is one fragment of a curved upward free tube portion. The umbilicus is wide to moderately wide. SD is 1.4–3.6 mm, TD 0.6–1.5 mm. All possess 3–6 keels, but mostly the keels are weakly developed, and in some specimens including the largest one they are hardly visible. The colour is pale violet and not very characteristic.

Discussion: Although it is hardly possible to affiliate a Mesozoic spirorbin tube to a certain genus if no operculum is present (except if it is a *Neomicrorbis*), the sense of coiling and the number of keels suggest an attribution to *Janua* (*Dexiospira*).

Spirorbinae, gen. et sp. indet.

(Pl. 10, Fig. 8)

2007 Spirorbidae, genus indet., n. sp. – Moosleitner: Pl. 10, Fig. 15.

Material: SdB1: 196 specimens (297 individuals; NHMW 2010/0021/0076, .../0118). SdB2: 34 specimens (62 individuals; NHMW 2010/0021/0119–0120).

Description and Discussion: The bulk of small spirorbin tubes from the SdB show no longitudinal ornament either because they are too worn or because they don’t possess any. Some of these specimens, especially the larger ones, the badly preserved ones and the dark violet ones, may presumably belong to one of the spirorbin species described above, or even to a spiral non-spirorbin serpulid, e. g. *Pseudomicrorbis pseudomicrorbis* or *Mucroserpula*? *bleytonensis*, if the non-spiral initial tube portion is not visible anymore.

However, the large majority of the specimens including many moderately and well-preserved tubes certainly represent one or more small-sized species lacking any distinct ornament. Certainly the majority of the specimens are not the juveniles of the other species. SD is usually smaller than circa 2 mm.

In contrast to the vast majority of extant spirorbin species, sinistral and dextral specimens occur in equal numbers (Pl. 10, Fig. 8): Out of 351 individuals, 173 are sinistral, 178 dextral.

Most specimens grow more or less planar. Only in a few specimens the tube slightly tends to coil helicoidally upward or to form a free portion. Umbilicus differs in size, but is usually rather wide. The species shows a distinct tendency towards gregarious settlement of the larvae, because up to seven spirorbin individuals, in one case even 16, had settled on a single substrate, often associated with non-spirorbin serpulids and other organisms.

The lack of any distinct ornament, the lack of finds of opercula, and the equal frequency of sinistral and dextral spirals makes it hardly possible to provide a useful species definition or to affiliate them to a certain genus.

An equal frequency of sinistral and dextral spirals is found only in the genus *Neomicrorbis* and in a single small-sized living species, *Janua steueri* (STERZINGER, 1909). The latter and also many of the *Neomicrorbis* species are distinctly ornamented, and, moreover, the *Neomicrorbis* tubes are usually relatively large in size. Therefore the mostly small and smooth SdB spirorbins do not seem to be closely related to neither of the two taxa just mentioned.

Substrate/epibiont relationships

Glomerula and all serpulids found at the SdB needed a solid substrate for settlement. 636 specimens from the main locality SdB1 were studied in detail for relationships between substrate and tube worms. (The specimens from SdB2 are less in number and on average less well preserved.) Nearly all substrates are bioclasts. Lithoclasts are rare (15 specimens; 2.4 per cent), and 4 specimens of these are the cylindrical lithified sediment fillings of burrows produced by invertebrates, whereas only a single lithoclast can be classified as a small pebble. The most common substrates for tube worms at SdB1 are oysters (47.2 per cent), followed by bryozoan colonies (23.3 per cent), brachiopods (11.9 per cent) and corals (2.4 per cent). All oyster specimens are only single valves of disarticulated shells, most of them small and planar. The bryozans are represented by several species, mainly of large and massive morphologies. Most of them are either nodular or tree-like with thick, massive stems and branches or tree-like with flattened branches. Slender ramified branches are less common. The most common brachiopods are rhynchonellids (8.0 per cent), followed by terebratulids (3.9 per cent). Most of the corals are worn fragments of branched species with large corallites, only one specimen is a nodular colony with small corallites.

However, these results are biased by the fact that many tube worm specimens from the SdB show no substrate anymore and could not be included in the 636 specimens mentioned above. Either they are fragments from which the former substrate was cut off mechanically, or the connection to the substrate was detached soon after death, or the substrate consisted of a material not preserved in the fossil state.

In Upper Cretaceous chalk or offshore marly limestone facies, many serpulids and especially the spirorbin *Neomicrorbis* had formerly been fixed to small cylindrical objects, presumably sea grass or algae, which had left a cylindrical mould at the tube base. In contrast, such cylindrical moulds caused by small cylindrical phytal substrates are very rare but present at the SdB (in three serpulid specimens of different species, two cylindrical moulds are 0.7–0.8 mm in diameter, one is 1.0 mm or a bit larger).

Due to the fact that only very few substrates had been bored by, e. g., drilling bivalves, cryptic environments are rare. Usually there are no deep cave-like hollows, but only shallow depressions or, most often, no depressions at all. Eight *Glomerula* specimens found detached from their former substrate show a low cone at their underside corresponding to a shallow depression in their former substrate. In principle this agrees with the observation by Wilson (1986) that in the Aptian of England *Glomerula*, at least in the young stage, prefers cryptic habitats. However, observations made at other localities show that *Glomerula* is an opportunist able to settle and to live on many different kinds of substrates of very different sizes and morphologies.

None of the serpulid species common at the SdB was specialized to settle on only one type of substrate. However, small undetermined spirorbin tubes ("Spirorbinae, gen. et sp. indet.") most often settled on oyster valves; an oyster valve is the substrate for 59.1 per cent of the small spinorbins, this is considerably more than the above mentioned average figure (47.2 per cent) for tube worms settling on oysters. In contrast, *Filogranula*? *provencalis* and *Neomicrorbis barremiensis* are the only serpulids which are more often fixed to bryozoans than to oysters. For *Filogranula*? *provencalis* it is assumed that this relatively heavy and possibly slow-growing tube needed a relatively large and heavy substrate which was stable for a certain period of time, for example a large and robust bryozoan colony.

Obviously the larger bioclasts had been used as relatively stable substrate for many epibionts (tube worms and others). In many bioclasts several generations of encrusters are fixed upon each other pointing, to calm periods of several months or even years without turning the bioclast around and without smothering the epibionts by sediment accumulation. Or, alternatively, the generations of encrusters accumulated during a series of shorter calm periods, interrupted by periods of smothering by sediment and later removal of sediment.

In a shallow water realm the bio- and lithoclasts are expected to be transported and turned upside down occasionally by water movement and by the action of marine animals. Indeed, 73 out of 300 oyster valves (24.3 per cent) are settled by epibionts on the outer as well as on the inner surface and had therefore probably been turned upside down. The small oyster valves are more or less planar objects and therefore provide the most reliable information. In contrast, in the more isodiametrical substrates, the lower surface which lies directly on the sediment and could therefore not be settled amounts to a much smaller percentage of the total surface, and therefore settlement of epibionts is often possible on opposite sites without turning the substrate around. This is especially true for the common large ramified bryozoans standing upright like a tree or bush on the sea-floor. Taken all kinds of substrates together, 22.0 per cent of the 636 substrate specimens from SdB1 are settled by epibionts on opposite sides. For the reason mentioned above, this figure is certainly larger than the true percentage of substrates turned upside down. Anyway, the true figure is in any case smaller than the more reliable percentage for the turned around oyster valves (24.3 per cent). This difference is easily explained by the fact that the small and relatively light oyster valves were more easily turned around than the massive bryozoan colonies.

Detailed statistical studies about epibionts have been published by several authors. An overview was provided by Taylor & Wilson (2003), a good special example was given by Taylor (1979) about the epibionts on a Middle Jurassic bivalve species. However, such a detailed study would be difficult for the SdB for the following reasons (among others): The material is only moderately preserved, and a high percentage of the fossil individuals can not be determined down to genus or species level. This is especially true for many of the specimens including more than one species of tubeworms. Moreover, many specimens are broken into fragments of different sizes, but it is very obvious that a large fragment contributes more reliable information about the encrustation history of the entire bioclast than only a small fragment.

If counting the substrate itself as the first generation, then up to five generations of organisms had settled upon and after each other. Taking the 636 specimens in which two generations (the substrate and at least one epibiont) are involved as a base for calculations, then 17.9 per cent show a third generation, 1.7 per cent a fourth generation and 0.3 per cent a fifth generation. The substrate generation had already been mentioned above. In most specimens of three generations or more, the latest generation is either a small bryozoan colony or a small tube worm, e. g. a *Vepreculina*, a small spirorbin or, less often, a *Filogranula*. These serpulids are among the most common tube worm species at the SdB. However, two other tube worm species common at the SdB, *Glomerula serpentina* and especially *Filograna filosa* (which is more common in SdB2), are less often found associated with other tube worms on the same piece. By their strategies of either forming fast-growing knots (*Glomerula*) or monospecific bundles of parallel tubes (*Filograna*), these two genera, at least during lifetime, tend to keep other tube worm species away.

Neglecting other organisms than tube worms, the most common combination of (at least) two tube worm species in a specimen includes *Vepreculina* and undetermined spirorbins (22 specimens from SdB1; in two cases each the *Vepreculina* grows upon the spirorbin, and vice versa). The next most common combinations include: *Vepreculina* and *Filogranula*? *provencalis* (9 specimens; in four cases the *Vepreculina* grows upon the *Filogranula*, and in two cases the *Filogranula* grows upon the *Vepreculina*); *Filogranula*? *provencalis* and undetermined spirorbins (8 specimens; in two cases the *Filogranula* grows upon the spirorbin, and in one case the spirorbin grows upon the *Filogranula*); *Pyrgopolon* and *Vepreculina* (7 specimens including 10 cases of interaction; in four cases each the *Pyrgopolon* grows upon the *Vepreculina*, and vice versa); *Pseudomicrorbis* and undetermined spirorbins (4 specimens providing no information about the order).

Cases in which specimens of the same species are growing upon each other are not further discussed here, but information about their gregariousness can be derived from the material lists by comparing the figures of specimens with (if given) the figures of individuals. The most gregarious species at the SdB are *Glomerula serpentina*, *Filograna filosa* (in part by asexual colony formation), *Metavermilia* (*Vepreculina*) *infracretacea*, *Filogranula*? *provencalis*, *Mucroserpula*? *bleytonensis* (occasionally), *Pseudomicrorbis pseudomicrorbis*, *Neomicrorbis barremiensis* (occasionally) and the undetermined spirorbins.

Initial phases of bioimmuration have happened in six specimens from SdB1: a *Glomerula serpentina*, a *Mucroserpula*? *bleytonensis*, three specimens of *Filogranula*? *provencalis* and a specimen with both a undetermined spirorbin and an undetermined serpulid. In all cases the tube worm had settled upon a massive bryozoan colony which in turn started to overgrow the base of the tube worm.

The symbiont *Protulophila gestroi* Rovereto, 1901 has infested serpulid tubes very rarely. The characteristic structures caused by this symbiont are only found in two tubes of *Mucroserpula*? *bleytonensis* from SdB2.

Results, General Discussion and Conclusion

The SdB polychaete fauna is extremely high diverse; circa 20 species bearing calcareous tubes are present. At SdB1 more specimens were found than at SdB2, but all common species are present at both sites, whereas some rare species are found only at SdB1. The sabellid *Glomerula serpentina* and the serpulids *Metavermilia* (*Vepreculina*) *infracretacea*, *Filogranula*? *provencalis* and undetermined spirorbins are the most common polychaetes with a calcareous tube at the Serre de Bleyton. However, at SdB2 *Filograna filosa* is more common than the taxa mentioned above.

The SdB fauna includes both surprisingly modern elements as well as "old-fashioned" forms resembling Jurassic species. On the one hand, some of the geologically earliest representatives of *Metavermilia* (*Vepreculina*) and of *Pyrgopolon* were found here, as well as one of the earliest common and relatively diverse occurrences of spirorbins. On the other hand, the sabellid *Glomerula* and the serpulid *Serpula* (*Cementula*) resemble Jurassic species.

Jäger (2005: 210) had stated that the change from the "old style" Jurassic and Lower Cretaceous serpulid fauna to the "new style" Upper Albian, Upper Cretaceous, and Palaeogene serpulid fauna occurred between the Aptian or Lower Albian and the Upper

Albian. However, the fauna from the Barremian of the SdB, although collected from a set of three sublocalities of very limited size each, represents a surprisingly high diverse serpulid fauna, including at least seven new species, some of them representing close relationship to Upper Cretaceous species. Obviously the faunal change in serpulids had occurred earlier in the Lower Cretaceous than hitherto thought and had even started in the Jurassic (IPPOLITOV 2010 and pers. comm.). The SdB fauna is of outstanding value for the research on the phylogeny of serpulids.

However, there are some problems: In several species from the SdB, affiliation to a well-established genus or subgenus is difficult, this is especially true for the spirorbins of which no operculum has been found and of which probably more genera and species are present than described above. There are also several “pretenders” which in general aspect look very much like well-established genera, but which lack important special features, e. g. the *Pentaditrupa*-like *Mucroserpula pentaditrupoidea* and the *Neomicrorbis*-like *Pseudomicrorbis pseudomicrorbis*. Some species belonging to a well-known genus or subgenus show unexpected special features like a circular cross-section in a normally square *Nogrobs* and only indistinct development of cellular construction of the tube base in *Pyrgopolon* (*Pyrgopolon*). Moreover, preservation of many specimens is poor. Most specimens are broken into fragments, the surface is often mechanically worn, firmly cemented sediment particles and bioclasts obscure portions of the tubes’ surface, and recrystallisation obscured many details of the tube structure.

In the descriptions the colour of the tube is stated. Of course, this does not mean that the tube had this colour already when the worm was still alive. Certainly diagenesis had changed the colour considerably. However, some of the differences in tint and shade, or at least the difference between the bright grey tubes on the one hand and the usually darker brownish violet tubes on the other hand, is presumed to be a reflection of either original differences in colour or, more likely, in original tube structure (or of differences in diagenesis pathways between the components of the turbidite). Anyway, colour, of course in combination with tube morphology, was a helpful, though not unequivocal, feature when sorting the material into species.

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Plate 1

***Glomerula serpentina* (Goldfuss, 1831)**

Fig. 1. Knot fixed to a shell; a. upper side; b. lateral view. Total D 5.6 mm, TD 0.8 mm. NHMW 2010/0021/0001.

Fig. 2. Large knot composed of several small tubes; a. upper side; b. underside. Total D 8.5 mm, TD mostly circa 0.6 mm, at maximum 0.8 mm. NHMW 2010/0021/0002.

Fig. 3. Curved initial tube portion passing into a meander, fixed to a planar bryozoan colony; upper side. D of area covered by the tube 8.7 mm, TD 0.6 mm. NHMW 2010/0021/0003.

Fig. 4. Spiral steinkern fixed to a fragment of an oyster (the upper curve belongs to the oyster shell), discrimination between *Glomerula* and *Serpula* (*Cementula*) is difficult; upper side. SD 4.3 mm, TD 0.7 mm. NHMW 2010/0021/0004.

Fig. 5. Large knot composed of many small tubes; upper side. Total D 7.4 mm, TD circa 0.4 mm. NHMW 2010/0021/0005.

Fig. 6. Elongated knot showing strong curvature of the tube; lateral view. Total D 8.2 mm, TD 1.0 mm. NHMW 2010/0021/0006.

Fig. 7. Fragment of only slightly curved free tube portion; a. posterior cross-section showing thick tube wall composed of two layers; b. lateral view. TL 5.7 mm, TD 1.1 mm. NHMW 2010/0021/0007.

Serpulidae, gen. et sp. indet. 1

Fig. 8. Tube fragment, somewhat compressed by diagenesis; upper side. TL 10.5 mm, TD 4.0 mm (was somewhat smaller originally). NHMW 2010/0021/0008.

Serpulidae, gen. et sp. indet. 2

Fig. 9. Fragment of the presumed free tube portion; a. cross-section; b. presumed underside. TL 11.5 mm, TD 3.2 mm. NHMW 2010/0021/0009.

***Filograna filosa* (Dujardin, 1837)**

Fig. 10. Bundle of many tubes; lateral view. L of bundle 11.0 mm, D of bundle 4.0 mm. NHMW 2010/0021/0010.

Fig. 11. Ramified bundle of many tubes; a. cross-section; b. lateral view. L of bundle 12.0 mm, W of bundle 10.8 mm, D of cross-section (a) 4.7 mm, TD 0.3-0.5 mm. NHMW 2010/0021/0011.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1–2, 4–7, 9–10 from locality SdB1; Figs 3, 8 and 11 from locality SdB2.

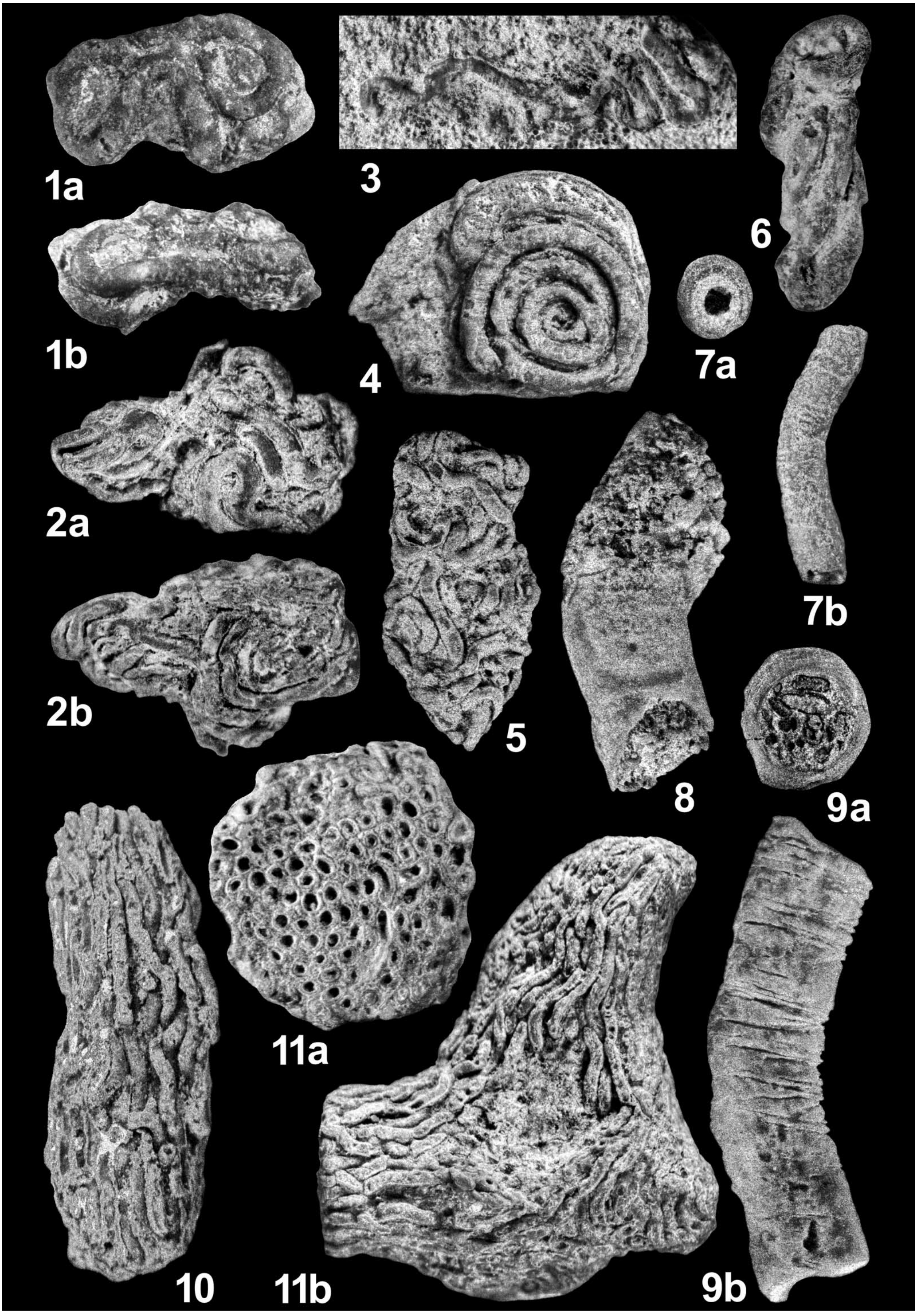
1a
3
6
1b
4
7a
2a
5
8
7b
2b
9a
11a
10
11b
9b

Plate 2

***Nogrobs* sp.**

Fig. 1. Tube fragment with different shape of the anterior and posterior cross-sections; a. circular, probably anterior cross-section; b. square, probably posterior cross-section (somewhat oblique view); c. upper side; d. lateral view, upper side is on the right. TL 7.5 mm, TW 1.4 mm. NHMW 2010/0021/0012.

Fig. 2. Tube fragment with constant cross-section throughout; a. square, probably anterior cross-section; b. underside. TL 6.9 mm, TW 1.4 mm. NHMW 2010/0021/0013.

***Rotulispira* sp.**

Fig. 3. Dextral spiral; upper side, inside corroded tube the steinkern is well visible. SD 9.3 mm, TD 2.7 mm. NHMW 2010/0021/0014.

Fig. 4. Dextral spiral; a. corroded upper side showing portion of the steinkern in lower left; b. underside; c. oblique view of the underside; (b) and (c) show short non-spiral initial tube portion near centre of spiral. SD 9.3 mm, TD 3.0 mm. NHMW 2010/0021/0015.

Fig. 5. Largest and best preserved, dextral spiral; a. upper side, the oblique band on the right is a crack caused by diagenesis pushing the free tube portion obliquely downward; b. underside; c. lateral view showing aperture on the left. SD 12.0 mm, TD 2.5 mm, TL of free anteriormost portion 2.0 mm. NHMW 2010/0021/0016.

***Serpula* (*Cementula*) sp.**

Fig. 6. Tube consisting of two spirals growing obliquely upon each other, anteriormost tube portion becomes three-keeled; a. upper side; b. oblique lateral view; c. opposite lateral view showing cross-sections of tubes. Total D 6.4 mm, SD of upper spiral 5.6 mm, TD 1.2 mm. NHMW 2010/0021/0017.

Fig. 7. Spiral fixed to a bryozoan colony with a short free tube portion growing obliquely downward; upper side. Total D 6.2 mm, SD 5.0 mm, TD 1.3 mm in the fixed as well as in the free portions, TL of free portion 1.2 mm. NHMW 2010/0021/0018.

Fig. 8. Fragment of free tube portion, showing alae-shaped peristomes; a. aperture; b. upper side, showing alae; c. underside, showing peristome spines. TL 4.0 mm, TD at peristomes 1.5 mm, TD between peristomes 0.8 mm. NHMW 2010/0021/0019.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1–4, 6–8 from locality SdB1; Fig. 5 from locality SdB3.

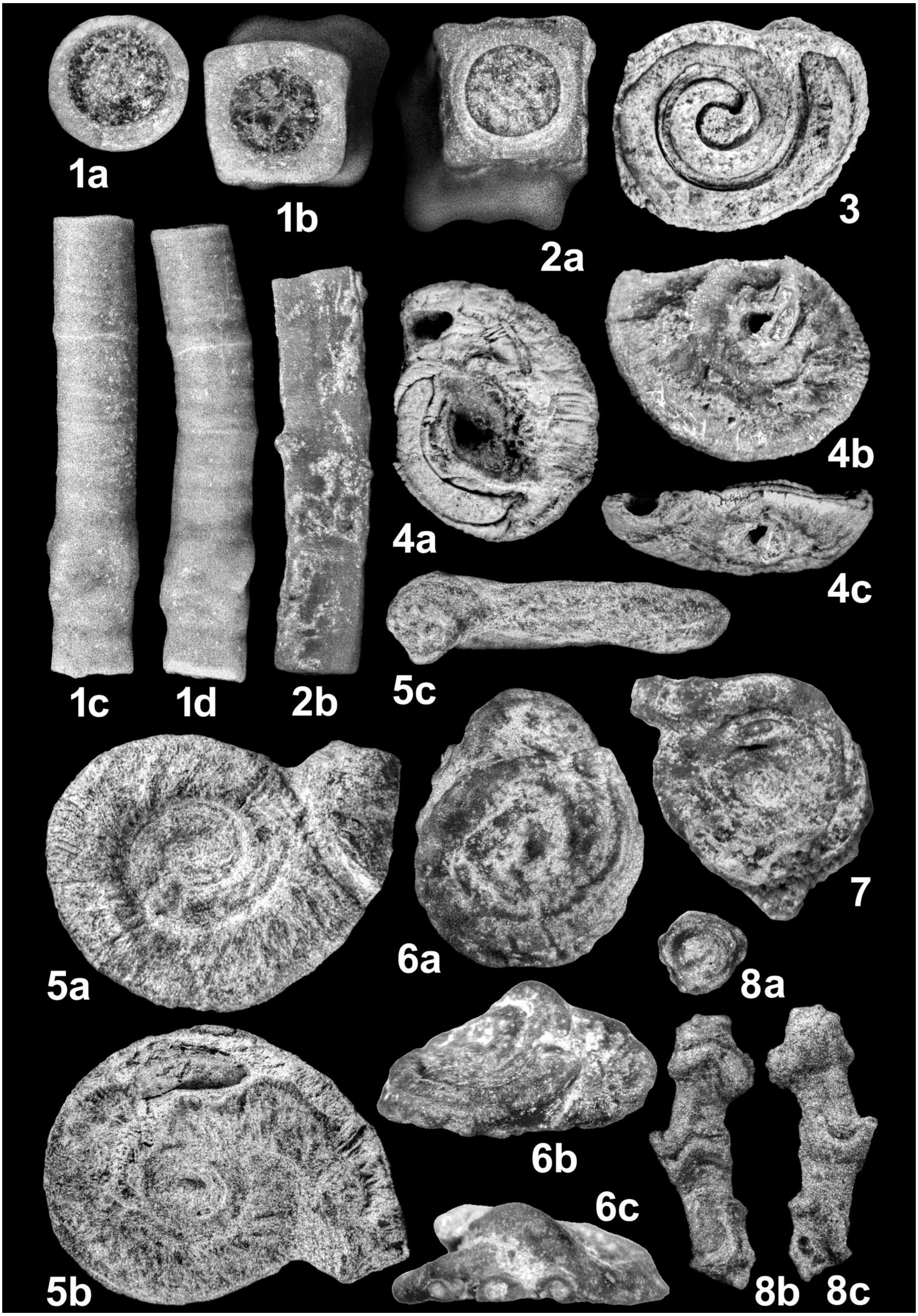
1a
1b
2a
3
1c
1d
2b
4a
4b
4c
5c
5a
6a
7
8a
6b
6c
5b
8b
8c

Plate 3

***Metavermilia* (*Vepreculina*) *infracretacea* nov. spec.**

Fig. 1. Fragment of free tube portion, showing three-spined peristomes; a. upper side, showing peristomes resembling 'alae'; b. lateral view, upper side is on the left; c. underside, showing spines of peristomes; d. aperture. TL 3.3 mm, TD 1.0 mm. NHMW 2010/0021/0020.

Fig. 2. Fixed tube portion forming loop; upper side. D of area covered by the tube 3.0 mm, TD 0.6 mm. NHMW 2010/0021/0021.

Fig. 3. Fixed tube portion with tunnel-shaped cross-section forming two loops, short free tube portion angles away from the substrate at 45 degrees; a. lateral view; b. upper side. Total D 2.6 mm, LD of upper loop 1.8 mm, TD 0.6 mm, TL of free portion 0.5 mm. NHMW 2010/0021/0022.

Fig. 4. Fixed tube portion forming spiral-like loop; oblique view to upper side, showing spine of peristome at lower left. Total D 3.7 mm, TD 0.9 mm. NHMW 2010/0021/0023.

Fig. 5. Many irregularly curved tubes fixed to the inner surface of a fragment of an irregular echinoid; upper side. Total L of area shown 9.5 mm, TD 0.2 mm. NHMW 2010/0021/0024.

Fig. 6. Fixed tube portion with tunnel-shaped cross-section forming loop and with peristomes; upper side. LD 2.2 mm, TD including peristome 0.8 mm. NHMW 2010/0021/0025.

Fig. 7. Holotype; tube with triangular cross-section forming inward coiling loop fixed to the concave inner surface of a bivalve shell; a. upper side; b. anterior cross-section; c. oblique lateral view. LD of preserved loop portion 3.2 mm, TD 0.8 mm. NHMW 2010/0021/0026.

Fig. 8. Fixed tube portion with triangular cross-section forming loop using own posterior portion as substrate, anteriormost portion fixed only by narrow edge; a. upper side; b. anterior cross-section. Total D 2.6 mm, TH 0.7 mm. NHMW 2010/0021/0027.

Fig. 9. Hook-shaped tube fragment with tunnel-shaped cross-section and peristomes fixed to the concave inner surface of a rhynchonellid brachiopod shell; a. upper side; b. posterior cross-section; c. anterior cross-section. D of area covered by tube 3.6 mm, TL of straight portion 2.7 mm, TD 0.9 mm including peristome. NHMW 2010/0021/0028.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France. All specimens from locality SdB1..

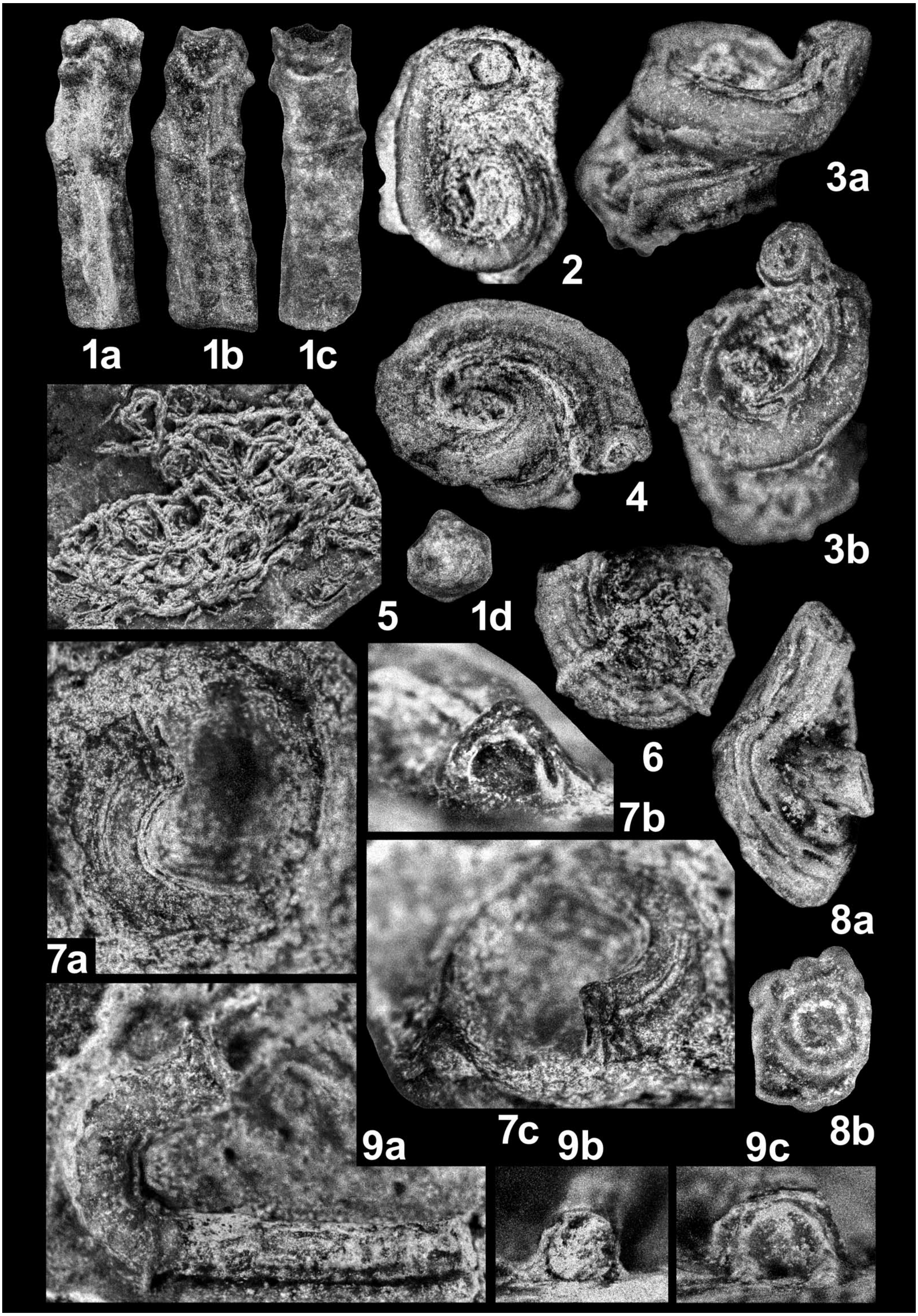
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Plate 4

Filogranula cincta **(Goldfuss, 1831)**

Fig. 1. Tube fragment fixed to a bryozoan colony; a. upper side; b. oblique lateral view; c. cross-section. TL 4.5 mm, TW 1.0 mm. NHMW 2010/0021/0029.

***Filogranula*? *provencalis* nov. spec., one-keeled variety**

Fig. 2. Two serpentine tubes fixed to a bryozoan colony, one tube showing transition to the broken off free portion; a. upper side; b. upper side, enlarged. Total D of specimen 9.2 mm, D of anterior curve 5.0 mm, TW 1.3 mm, TH 1.5 mm. NHMW 2010/0021/0030.

Fig. 3. Tube forming loop of 1⅓ whorls fixed around an irregular substrate in a manner similar to the genus *Dorsoserpula*; bioclast sticking inside aperture; a. lateral view showing aperture; b. aperture enlarged; c. upper side showing protruding keel above aperture. LD 4.0 mm, TW 1.5 mm. NHMW 2010/0021/0031.

Fig. 4. Tube forming inward loop of 1⅔ whorls fixed to a convex rhynchonellid brachiopod shell; a. upper side; b. another oblique lateral view. LD 5.0 mm, TW 1.8 mm. NHMW 2010/0021/0032.

Fig. 5. Tube forming loop of 1½ whorls fixed to a planar bivalve shell with a short free tube portion which angles away from the substrate at 70 degrees, bioclast obscuring umbilicus; a. oblique view to upper side showing aperture; b. upper side showing short free tube portion. LD 3.6 mm, TW 1.4 mm, TL of free portion 1.5 mm. NHMW 2010/0021/0033.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France. All specimens from locality SdB1.

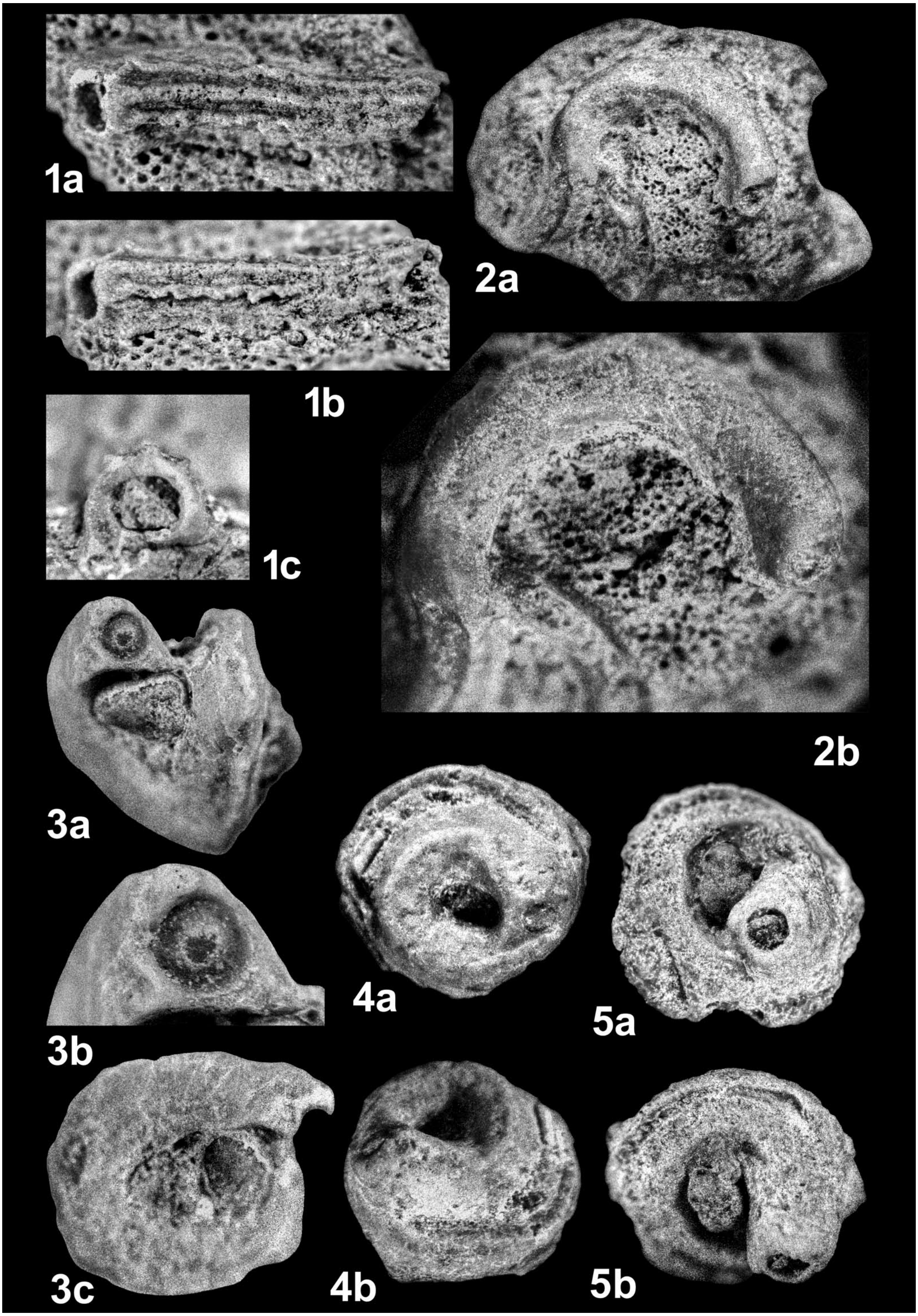
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Plate 5

***Filogranula*? *provencalis* nov. spec., three-keeled variety**

Fig. 1. Strongly curved tube fixed to a gastropod shell, with transition to the free portion, a bioclast is sticking in the aperture; a. oblique view to upper side, aperture at upper centre; b. upper side, aperture at upper left; c. upper side / lateral view, aperture at lower left; d. enlarged view of aperture. Total size 8 mm x 7 mm, TW 1.8 mm at maximum and 1.5 mm at aperture. NHMW 2010/0021/0034.

Fig. 2. Curved tube fragment fixed to a bryozoan colony; a. upper side; b. anterior cross-section with longitudinal canals at the base. TL of segment shown in (a) 4.5 mm, TW 1.0 mm, TH 1.0 mm. NHMW 2010/0021/0035.

Fig. 3. Curved tube fragment fixed to a bryozoan colony and to another serpulid tube; a. upper side / lateral view; b. anterior cross-section at the transition to the free tube portion. TL of segment shown in (a) 3.7 mm, TW 1.5 mm. NHMW 2010/0021/0036.

Fig. 4. Tube fragment forming loop fixed to a strongly ribbed rhynchonellid brachiopod, upper half of the anterior tube portion is broken off; a. oblique view to upper side; b. oblique lateral view. W of total specimen 5.6 mm, LD 4.5 mm, TW 1.7 mm. NHMW 2010/0021/0037.

Fig. 5. Anterior end of fixed tube with a short and rounded spine above aperture; a. aperture; b. upper side. TW 1.4 mm, TH 1.5 mm. NHMW 2010/0021/0038.

Fig. 6. Curved tube fragment fixed to a ball-shaped bryozoan colony; oblique view to upper side. D of bryozoan colony 10 mm, TW 1.5 mm. NHMW 2010/0021/0039.

Fig. 7. Slightly curved fragment of an either free or loosely clinging tube portion; a. aperture; b. lateral view, upper side is on the right; c. upper side; d. opposite lateral view, upper side is on the left. TL 6.5 mm, TH 1.2 mm. NHMW 2010/0021/0040.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France. All specimens from locality SdB1.

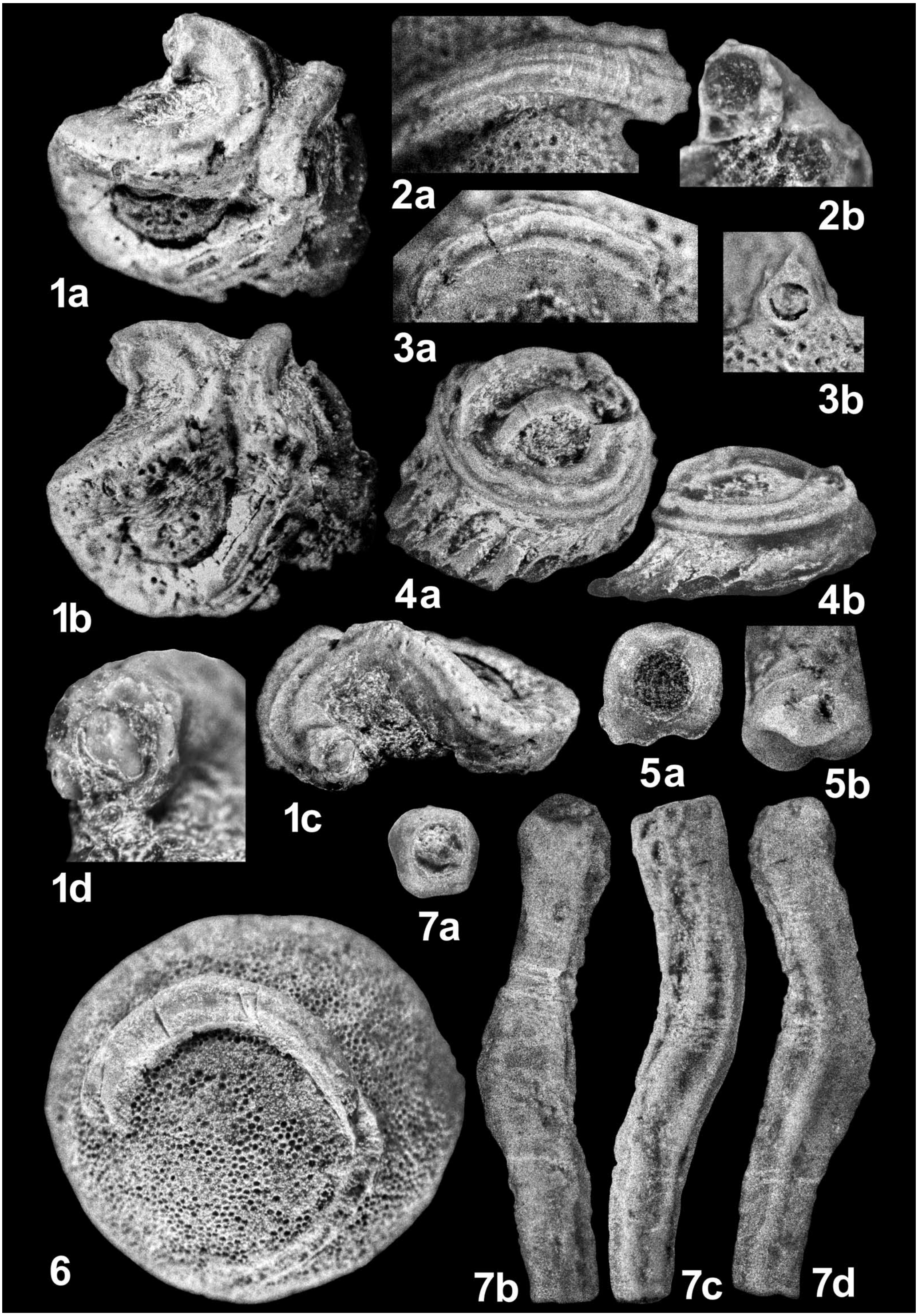
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Plate 6

***Filogranula*? *provencalis* nov. spec., three-keeled variety**

Fig. 1. Holotype; free tube portion with two peristomes, in the posterior peristome the two lower spines protrude longer than the other three spines; a. upper side; b. lateral view, upper side is on the right; c. underside showing longitudinal furrow; d. aperture. TL 4.6 mm, TW including peristome 1.6 mm, TH 1.8 mm. NHMW 2010/0021/0041.

Fig. 2. Free tube portion with a peristome at the aperture, the three upper spines of the peristome protrude longer than the two lower spines, upper lateral keels well developed; a. upper side; b. lateral view, upper side is on the right; c. aperture. TL 4.5 mm, TW 1.7 mm including peristome, TH 1.7 mm. NHMW 2010/0021/0042.

Fig. 3. Fragment of fixed tube portion with a peristome and with an additional longitudinal keel on the right latus; a. upper side; b. lateral view showing additional lateral keel, upper side is on the left; c. anterior cross-section. TL 4.0 mm, TW 1.4 mm including peristome. NHMW 2010/0021/0043.

Fig. 4. Fragment of free or at most loosely clinging tube portion; a. upper side; b. oblique view on the strongly ornamented underside (on the right) and on the latus (on the left); c. aperture. TL 2.3 mm, TW 1.8 mm including peristome, TW of oblique view in b 2.4 mm, TH 1.8 mm. NHMW 2010/0021/0044.

Fig. 5. Free tube portion with a massive, thick-walled peristome; a. upper side; b. underside, showing longitudinal furrow; c. aperture. TL 3.0 mm, TW 2.0 mm including peristome. NHMW 2010/0021/0045.

Fig. 6. Two tubes fixed to each other; lower tube consists of portion which formerly was fixed to an unknown substrate and a free portion which angles away from the substrate at 20 degrees and a peristome, upper tube fixed to the lower one for all of its preserved length; a. apertures of both tubes; b. underside of lower tube; c. lateral views of both tubes, the lower tube is on the right, the apertures are on top. Total L 5.5 mm, TL 5.0 mm each, TD of lower tube 1.8 mm including peristome, TW of upper tube 1.3 mm, TH of upper tube 1.6 mm. NHMW 2010/0021/0046.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France. All specimens from locality SdB1.

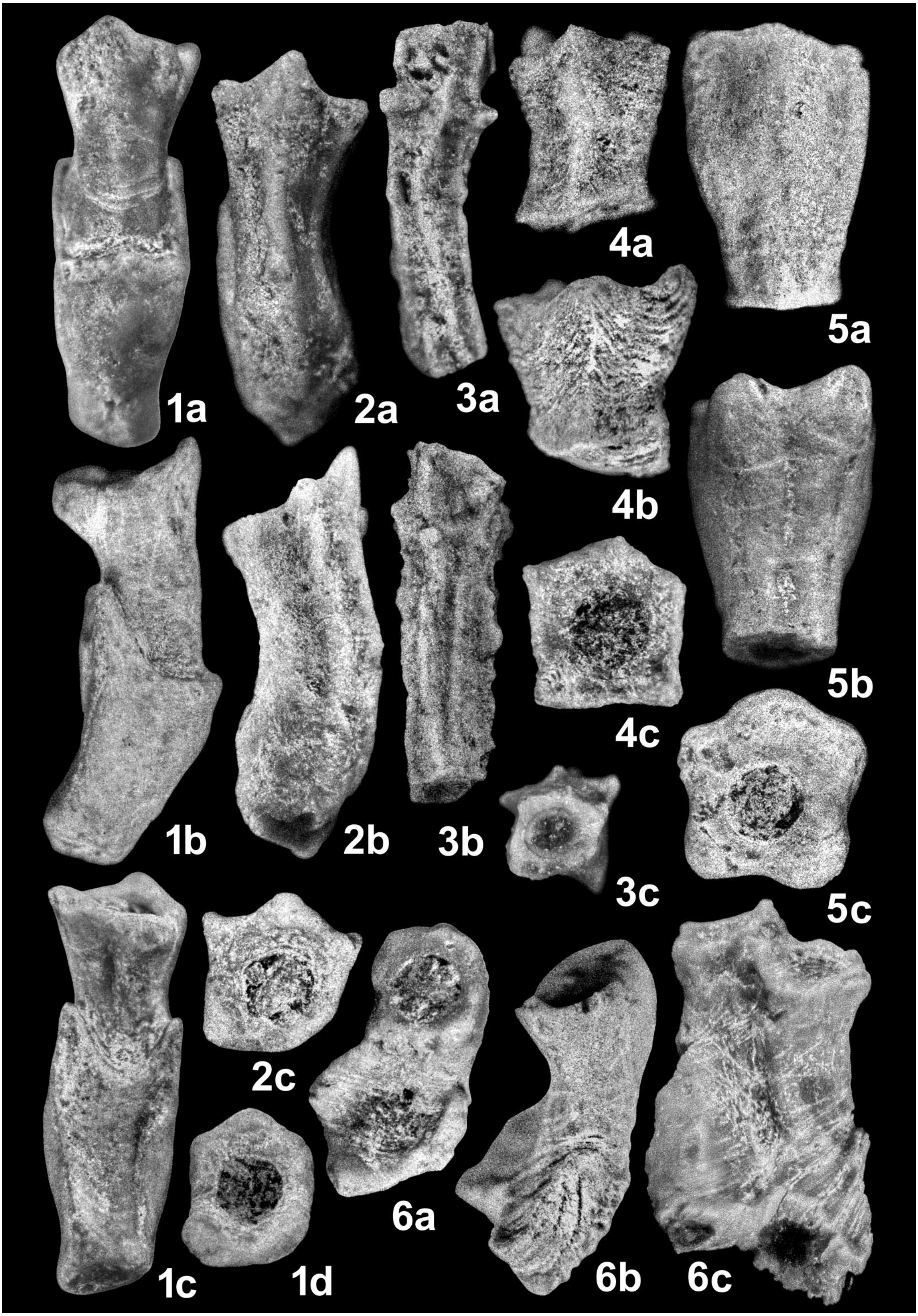
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Plate 7

***Mucroserpula pentaditrupoidea* nov. spec.**

Fig. 1. Holotype; fragment of free portion encrusted by a bryozoan colony; a. anterior cross-section; b. upper side; c. lateral view. TL 7.7 mm, TD 3.5 mm. NHMW 2010/0021/0047.

Fig. 2. Fragment of free portion; a. posterior cross-section; b. upper side. TL 7.0 mm, TD 3.1 mm. NHMW 2010/0021/0048.

Fig. 3. Aperture of free portion. TW 3.0 mm, TH 3.8 mm. NHMW 2010/0021/0049.

Mucroserpula? bleytonensis nov. spec.

Fig. 4. Straight intermediate tube portion followed by a loop of ¾ whorl, median keel is wider and lower than the lateral keels; a. upper side; b. oblique lateral view. Total D 6.4 mm, TD 2.8 mm. NHMW 2010/0021/0050.

Fig. 5. Fixed tube forming loop of at least one whorl followed by a short free portion which angles away from the substrate at 70 degrees, the three keels are equal in size; a. upper side; b. lateral view. LD 6.4 mm, TD 2.6 mm, TL of free portion 1.0 mm. NHMW 2010/0021/0051.

Fig. 6. Fixed tube forming loop of 1¾ whorls followed by a short fragment of the free portion which angles away from the substrate at 20 degrees, median keel is wider than the keels at the edges; a. upper side; b. oblique lateral view. LD 4.7 mm, TW 2.3 mm, TL of free portion 0.5 mm. NHMW 2010/0021/0052.

Fig. 7. Holotype; at least four curved or serpentine tubes crowded together on an oyster shell, the three keels are equal in size, the holotype is seen on upper third of (a), upper fifth of (b), upper right of (c) and in (d); a. part of upper side; b. oblique view to upper side; c. oblique lateral view; d. aperture of holotype, which angles away from the substrate at 20 degrees. Total sizes: L 11.0 mm, W 7.4 mm, H 7.4 mm; sizes of holotype: visible TL (somewhat curved in posterior portion) circa 6.0 mm, TW 2.0 mm, TH 2.7 mm, TL of free portion 0.8 mm. NHMW 2010/0021/0053.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1–6 from locality SdB1; Fig. 7 from locality SdB2.

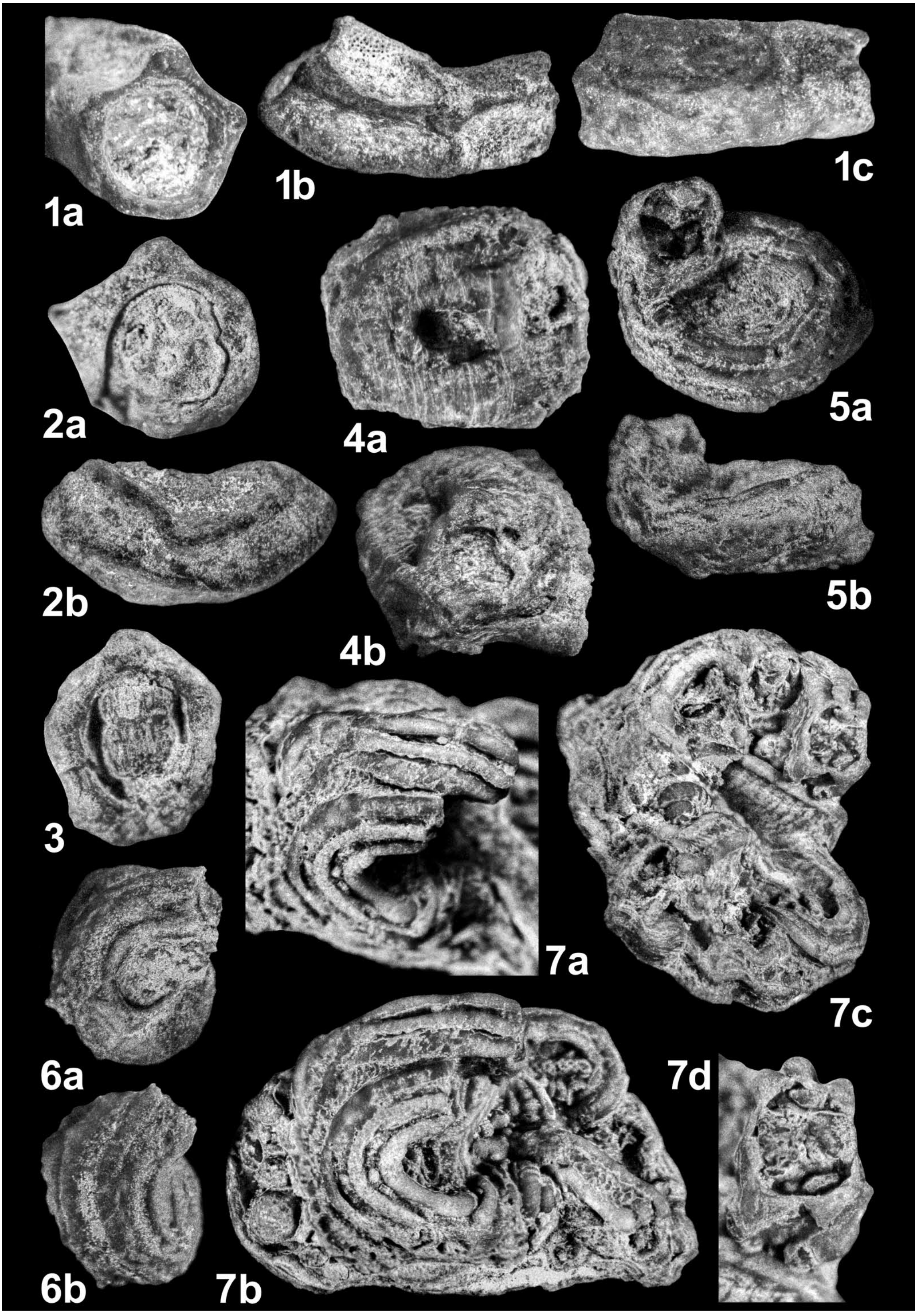
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Plate 8

***Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* nov. spec.**

Fig. 1. Small three-keeled tube fragment fixed to a thin planar bivalve shell, in (b) the anterior is on the left; a. anterior cross-section; b. upper side. TL 4.0 mm, TW 2.1 mm, TH 1.4 mm. NHMW 2010/0021/0054.

Fig. 2. Holotype; fragment of three-keeled fixed and seven-keeled free tube, in (b), (c) and (d) the anterior is on the left; a. anterior cross-section; b. upper side; c. lateral view, the three quarters on the right were fixed to a curved substrate, the quarter on the left is the free portion; d. underside, showing cave-like depression (filled by a bryozoan bioclast) at the transition from the fixed to the free portion and the lowest four of the seven keels of the free portion; e. posterior cross-section. TL 7.5 mm, TW 3.0 mm, total H 4.0 mm, TH of anterior cross-section 3.5 mm. NHMW 2010/0021/0055.

Fig. 3. Fragment of three-keeled fixed and seven-keeled/combed free tube, in (b), (c) and (d) the aperture is on the left; a. aperture; b. upper side; c. lateral view showing high and protruding median comb, the right half was fixed to a substrate, the left half is the free portion, the depression above the centre was presumably caused by diagenetic compression; d. underside showing oblique view of the posterior fracture on the right and furrow on the underside of the free portion on the left. TL 8.8 mm, TW 3.0 mm, total H 3.8 mm, TH at aperture 3.6 mm. NHMW 2010/0021/0056.

Fig. 4. Fragment of fixed tube; a. presumed anterior cross-section showing high median comb; b. oblique lateral view, the presumed anterior is on the right; c. presumed posterior cross-section. TL 8.3 mm, TW 4.0 mm, TH 4.4 mm. NHMW 2010/0021/0057.

Fig. 5. Fixed tube forming a loop around an upright standing bryozoan colony, in a manner very similar to the genus *Dorsoserpula*; a. lateral view, aperture at the transition from the fixed to the not developed free portion on the left, showing protruding keel/comb; b. view showing upper side of posterior portion with keel in the centre and upper left and the wide and rounded keel/comb spine above the aperture on the upper right. LD 11.0 mm, TH at aperture 3.5 mm including keel. NHMW 2010/0021/0058.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1–4 from locality SdB1; Fig. 5 from locality SdB2.

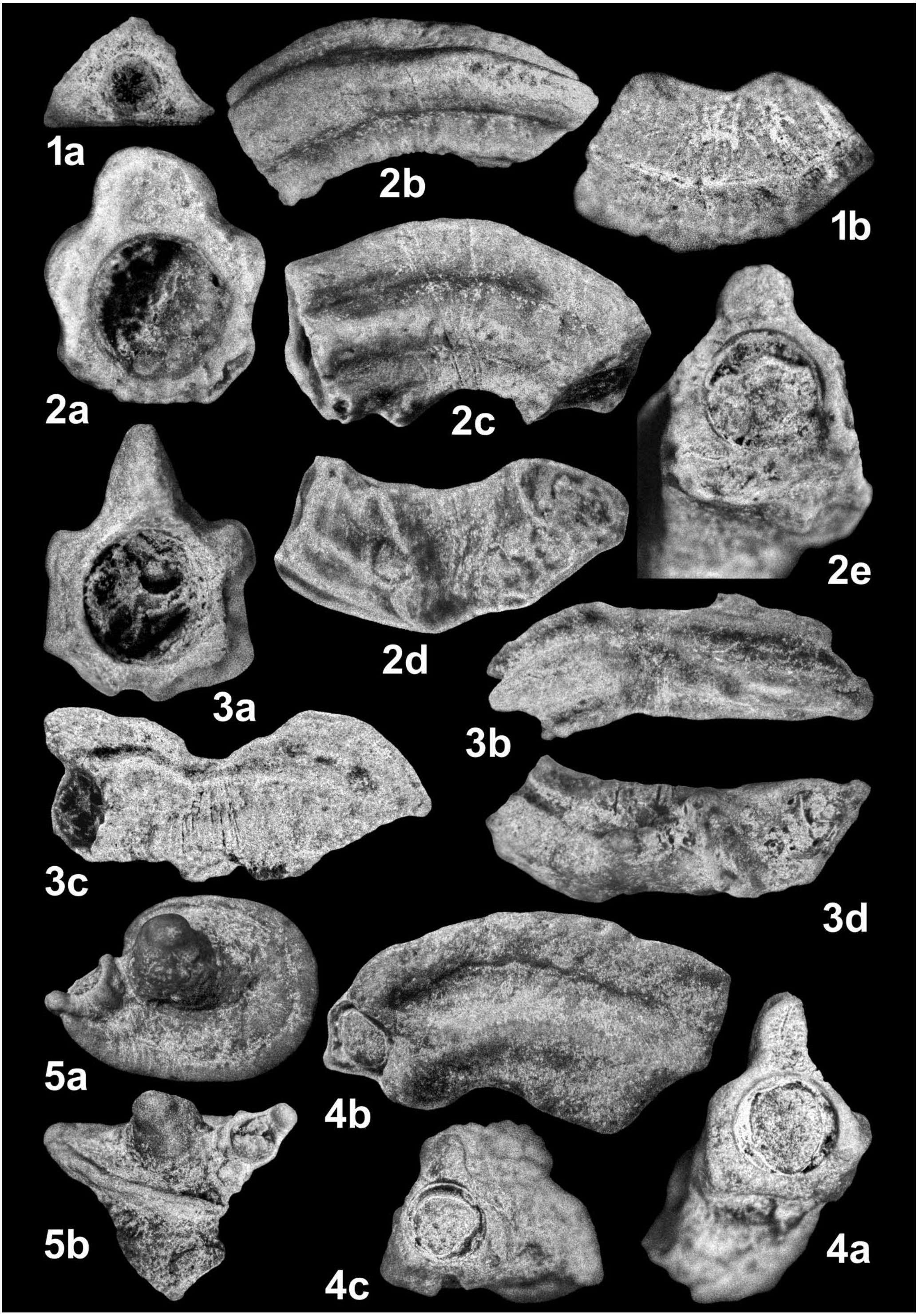
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Plate 9

***Pyrgopolon* (*Pyrgopolon*?) *moosleitneri* nov. spec.**

Fig. 1. Fragment of thin-walled free tube portion, bryozoan bioclast sticking inside aperture, in (a) and (b) the aperture is on the right; a. upper side; b. lateral view showing protruding comb; c. aperture. TL 7.6 mm, TW 2.3 mm, TH 3.0 mm. NHMW 2010/0021/0059.

Fig. 2. Fragment of triangular tube fixed to a shell fragment; anterior cross-section. Total W and total H including substrate as seen in the photograph 6.0 mm and 5.5 mm, TW 3.3 mm, TH 3.0 mm. NHMW 2010/0021/0060.

Fig. 3. Fragment of thin-walled fixed and free tube, laterally compressed by diagenesis, fixed by an only narrow area at the tip of the base, in (a) the anterior is on the right; a. lateral view; b. oblique view at posterior cross-section. TL 5.5 mm, TW 2.3 mm (was larger before compression), TH 4.1 mm (was lower before compression). NHMW 2010/0021/0061.

Fig. 4. Tube fragment fixed to a fragment of another, larger serpulid tube; cross-section showing thin inner tube wall layer partly separated from the outer layer. TW at base 2.7 mm. NHMW 2010/0021/0062.

***Pseudomicrorbis pseudomicrorbis* nov. gen. nov. spec.**

Fig. 5. Sinistral loop around lithoclast with a large near-straight initial tube portion; a. upper side; b. lateral view, showing aperture above initial tube portion. Total D 2.5 mm, TW 0.9 mm, TH 0.8 mm. NHMW 2010/0021/0063.

Fig. 6. Holotype; dextral loop/spiral of 12/3 whorls with a near-straight initial tube portion (not visible in the figures) and with 14 longitudinal rows of pits; a. upper side; b. lateral view. SD 3.7 mm, TD 1.4 mm. NHMW 2010/0021/0064.

Fig. 7. Dextral loop/spiral of 12/3 whorls with a slightly serpentine initial tube portion and with a short free tube portion which angles away from the substrate at 20 degrees; oblique view to upper side. SD 3.6 mm, TD 1.4 mm, TL of free portion 0.8 mm. NHMW 2010/0021/0065.

Fig. 8. Sinistral loop/spiral of 11/3 whorls preserved, initial tube portion broken off, with very well preserved rows of pits and with two short and sharp peristomes; a. upper side; b. lateral view; c. another lateral view showing the two peristomes protruding towards the base, the cross-sections of small tubes in the centre and upper right are undetermined serpulids. SD 3.5 mm, TD 1.3 mm. NHMW 2010/0021/0066.

Fig. 9. Dextral loop/spiral of 2¼ whorls fixed to a shell fragment with an initial tube portion forming a curve outside the spiral; a. lateral view, tube damaged above the centre of the figure; b. opposite lateral view, broken open initial tube portion visible below main spiral on the right. Total H including substrate 4.7 mm, total W of (b) including substrate 4.5 mm, SD 3.6 mm, TD 1.6 mm. NHMW 2010/0021/0067.

***Janua*? (*Dexiospira*?) sp.**

Fig. 10. Planar dextral spiral with three keels anterior tube portion damaged, fixed to a brachiopod shell fragment; upper side. SD of well preserved inner portion 2.0 mm, TD 0.7 mm. NHMW 2010/0021/0068.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1 and 3–10 from locality SdB1; Fig. 2 from locality SdB2.

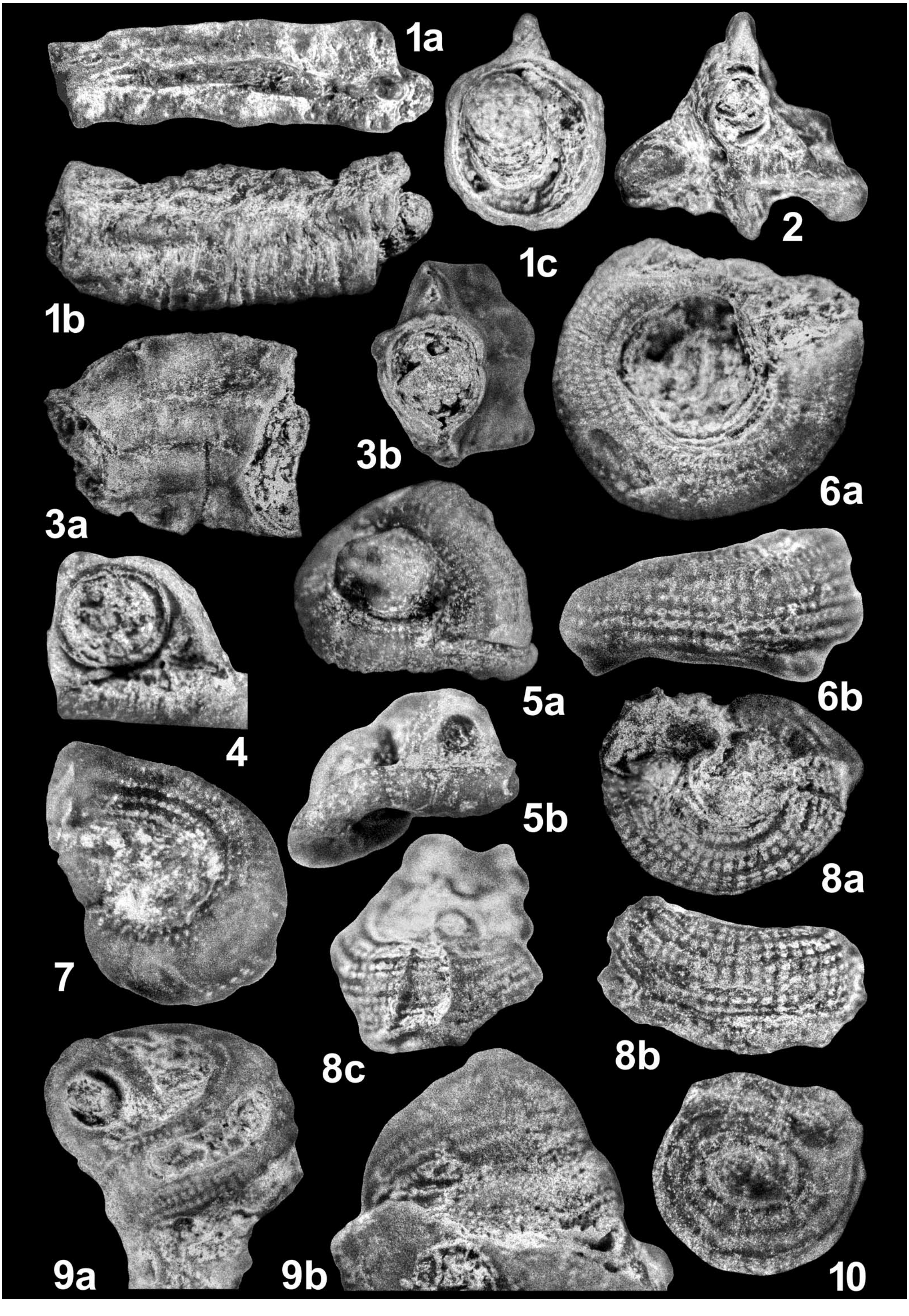
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Plate 10

***Neomicrorbis barremiensis* nov. spec.**

Fig. 1. Holotype; sinistral spiral with short free tube portion; a. upper side; b. oblique lateral view; c. underside showing spiral initial tube portion. Total D 5.3 mm, total H 1.9 mm, TD 1.6 mm, TL of free portion 1.0 mm. NHMW 2010/0021/0069.

Fig. 2. Small dextral spiral fixed to a bryozoan colony with a very long free portion; a. lateral view; b. opposite lateral view. Total H 4.7 mm, SD 2.5 mm, TD 2.0 mm, TL of free portion 3.5 mm. NHMW 2010/0021/0070.

Fig. 3. Dextral spiral (at the periphery preserved as steinkern only) with short free portion with flaring aperture; a. upper side; b. oblique lateral view showing aperture; c. frontal view showing aperture. Total D 4.3 mm (was larger originally), total H 2.3 mm, SD 3.0 mm (was larger originally), TD 2.1 mm. NHMW 2010/0021/0071.

Fig. 4. Dextral spiral with flaring aperture; a. upper side; b. lateral view. SD = total D 3.5 mm, total H 1.7 mm, TD 1.8 mm. NHMW 2010/0021/0072.

***Pileolaria*? sp. 1**

Fig. 5. Sinistral planar spiral with five inconspicuous keels fixed by a well-developed seam to an oyster shell; a. upper side; b. lateral view. SD 2.7 mm, TD 1.0 mm. NHMW 2010/0021/0073.

***Pileolaria*? sp. 2**

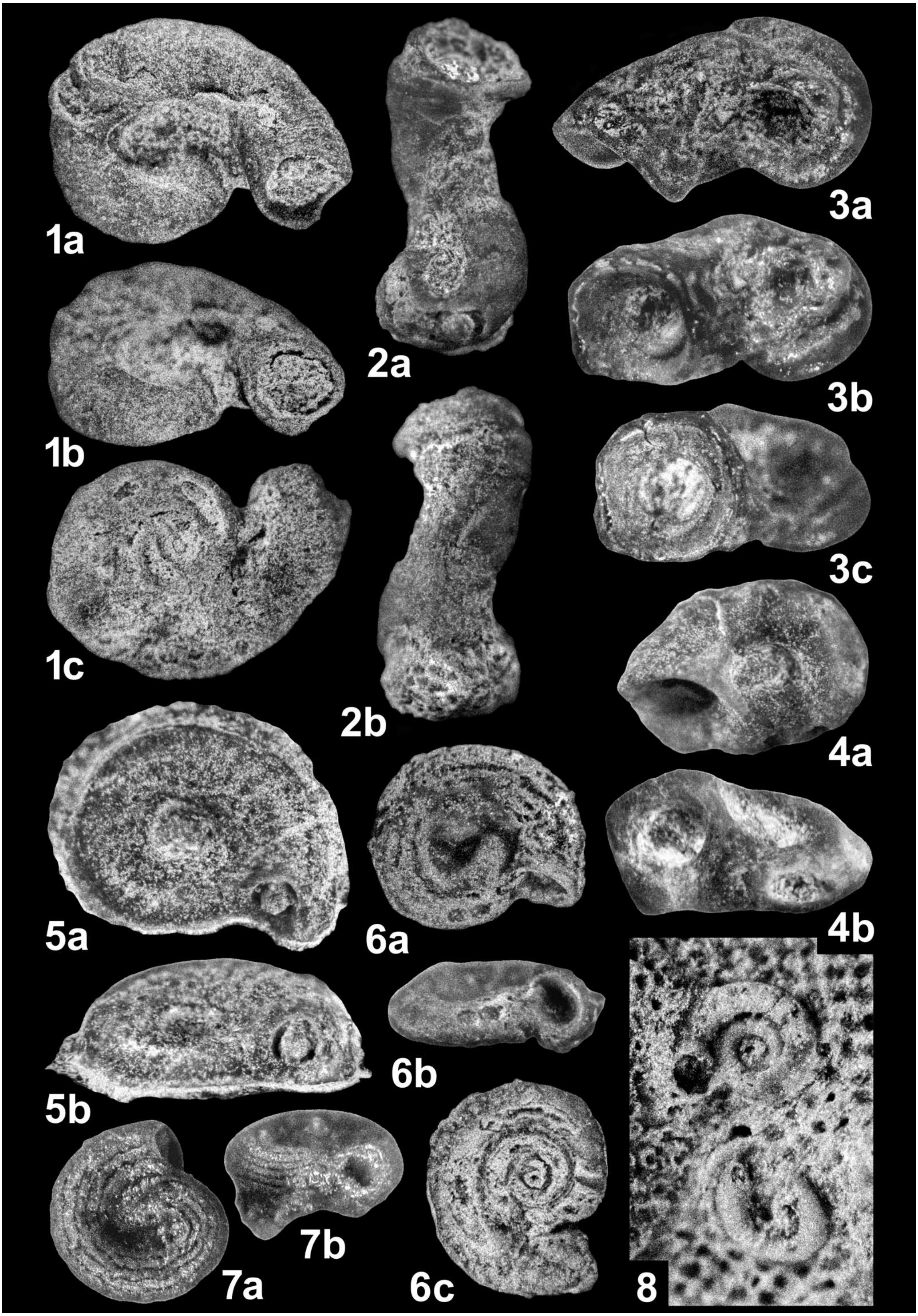
Fig. 6. Sinistral spiral with nine small keels; a. upper side; b. lateral view. SD 1.1 mm, TD 0.4 mm. NHMW 2010/0021/0074.

Fig. 7. Sinistral spiral with seven small keels; a. upper side; b. lateral view. SD 2.0 mm, TD 0.7 mm. NHMW 2010/0021/0075.

Spirorbinae, gen. et sp. indet.

Fig. 8. Two tubes preserved as steinkerns only, one sinistral, one dextral, fixed to a bryozoan colony; upper side. Upper tube: SD 1.0 mm, TD 0.3 mm; lower tube: SD 0.9 mm, TD 0.25 mm. NHMW 2010/0021/0076.

All specimens from the Barremian of the Serre de Bleyton, Drôme, SE France; Figs 1–4 and 6–8 from locality SdB1; Fig. 5 from locality SdB2.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