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Brachiopods from the Plattenwald Bed (Albian, Cretaceous) of the Helvetic Alps of Vorarlberg (Austria)

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Key words: Brachiopods, new species, Plattenwald Bed, conditions of accumulation, Helvetic nappes, Albian, Cretaceous, Vorarlberg, Austria

ABSTRACT

The brachiopods of the Plattenwald Bed (Albian, Cretaceous) of diverse localities in the Helvetic nappes of Vorarlberg (Austria) are described. The most abundant faunal element are terebratulids (*Moutonithyris dutempleana*, showing a distinct dimorphism: A "obtusa type"; B "dutempleana type"), followed by rare rhynchonellids (*Orbirhynchia parkinsoni*, *Burrirhynchia tripartita*) and a new terebratellid, *Gemmarcula ? plattenwaldensis* sp. nov. Further brachiopods are very rare and have not yet been studied. The brachiopods are discussed with regard to the lithology and the depositional environment of the Plattenwald Bed and with regard to their possible provenance.

ZUSAMMENFASSUNG

Die Brachiopoden der Plattenwald-Schicht (Albian, Kreide) von verschiedenen Fundorten der Helvetischen Decken von Vorarlberg (Österreich) werden beschrieben. Die Fauna umfasst als häufigstes Element Terebratuliden (*Moutonithyris dutempleana* mit deutlichem Dimorphismus: A "obtusa-Typ"; B "dutempleana-Typ), die wesentlich selteneren Rhynchonelliden *Orbirhynchia parkinsoni* und *Burrirhynchia tripartita* und ein neuer Terebratellide, *Gemmar-cula ? plattenwaldensis* sp. nov. Weitere Brachiopoden sind sehr selten und noch nicht näher untersucht. Die Brachiopoden werden im Zusammenhang mit der Lithologie und den Ablagerungensbedingungen der Plattenwald-Schicht und ihrer möglichen Herkunft diskutiert.

1. Introduction

The knowledge of Early Cretaceous brachiopods in the Helvetic nappes mainly rests on ancient publications such as those of Ooster (1863), Bachmann (1864), Kaufmann (1877) and on generalized fossil lists from geological publications. In the swiss and french Jura Mountains the knowledge of the corresponding brachiopods can be based on the pioneering work of Loriol (1864, 1868) and Pictet (1872), dating back to the 19th century, and revisions by Burri (1953, 1956), Gaspard (1989, 1997, 1999) and Middlemiss (1981, 1983, 1984, 1989).

Towards the end of the Early Cretaceous, during the final drowning phase of the latest Aptian, the widespread carbonate platforms („Schrattenkalk" Formation) ceased to develop. Due to a fundamental change in the conditions of sedimentation an episode of very slow accumulation took place, resulting in condensed phosphatic horizons which are part of the Garschella Formation (Gebhard 1985, Föllmi 1989a, Föllmi et al. 1994). In these rocks of limited extent (e.g. Durschlägi and Sellamatt Beds in Switzerland) brachiopods occur only sporadically. One of these phosphatic layers, however, the so-called Plattenwald Bed in the eastern Helvetic of Vorarlberg, has yielded not only a rich ammonite fauna, allowing biostratigraphical dating (Föllmi 1989b), but also sponges, endobenthic and epibenthic bivalves, gastropods, echinoderms, and a small, diverse brachiopod fauna. These brachiopods, listed in Heim & Seitz (1934), have hitherto never been figured or described. As they constitute an important episode in the history of the Alpine Cretaceous, we decided to study them in more detail in the present paper. An improved taxonomy may help to compare them with other coevel brachiopod communities and may contribute to paleogeographic questions.

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Fig. 1. Location map of the Plattenwald Bed (Cretaceous, Albian) in Vorarlberg (Austria). P: Plattenwald; O: Orsanka; S: Sattelberg; Go: Gopfberg; R: Rotenbachalpe; Gu: Gütle; L: Lädtobel; A: Achbrücke.

2. Geological setting

Mainly specimens housed in the Vorarlberger Naturschau, Dornbirn (Austria) were used for this study. Most of them had been collected by the founder of the museum, Siegfried Fussenegger, and are listed in Heim & Seitz (1934). Some specimens originate from (formerly) private collections. The brachiopods were found at the following localities (Fig. 1):

Plattenwald (GKR coordinates -51405 / 242355), about 0.75 km NE of Klaus. A small outcrop described by Heim & Seitz (1934), which was already sampled by Fussenegger, was designed as stratotype of the „Plattenwald-Schicht" by Föllmi & Ouwehand (1987). This phosphatic condensed bed lies above a dark, glauconitic sandstone („Brisi-Sandstein") succeeded by 0.4 m glauconitic sandstone with abundant extraclasts, but rare macrofossils („Klauser Schichten"). The rich ammonite fauna of the Plattenwald Bed (Föllmi 1989b) contains predominantly *Leymeriella* spp. and *Douvilleiceras* ex gr. *mammillatum* (Schlotheim) (Lower Albian: tardefurcata- and mammillatum-zones). Younger ammonites are rare (up to inflatum-zone).

The rock is extremely weathered leaving phosphatic internal casts in a sandy matrix. An additional outcrop (GKR coordinates –51550 / 242300 / ± 40 m) can be found approximately 150 m west of the stratotype. A gentle slope is extremely burrowed by fossil collectors. Most ammonites (except small fragments) have been removed, but brachiopods (as well as bivalves) are still abundant.

Orsanka, about 1.25 km ENE of Klaus. East of the stratotype the Plattenwald Bed is exposed in several small outcrops (GKR coordinates of main outcrop: –50820 / 242435). Ammonites indicate the mammillatum-zone as well as the tardefurcata-zone by a recent find of *Leymeriella intermedia* Spath. One outcrop provided large specimens of *Moutonithyris dutempleana* (d' Orbigny).

Sattelberg (GKR coordinates –52730 / 241880). The steeply dipping Plattenwald Bed is exposed on a slope about 1 km W of Klaus. It is overlain by pelagic limestone of the Seewen Formation („Seewerkalk"). As in the stratotype ammonites represent the tardefurcata- and mammillatum-zones, but also very rarely the dentatus-zone.

Gopfberg (GKR coordinates -32400 / 247270). This outcrop in the Bregenzerwald area approximately 1.2 km SE of Reuthe was described by Heim & Seitz (1934) as a phosphatic bed overlying glauconitic sandstone („Brisi-Sandstein"). Besides some undetermined specimens of *Phylloceras*, *Leymeriella pseudoregularis* Seitz and *Douvilleiceras* ex gr. *mammillatum* (Schlotheim) are the only ammonites found in this outcrop.

Rotenbachalpe (GKR coordinates -37200 / 250150). No lithological description is given by Heim & Seitz (1934) of this location, approximately 2.9 km SSW of Schwarzenberg. Ammonites (determined by Seitz) indicate a Lower to early Middle Albian age.

Gütle – Kraftwerk Ebensand (GKR coordinates -41980 / 249000). The extremely fossiliferous bed was found near the entrance of the romantic Alploch Gorge 4.75 km SE of Dornbirn. The strongly weathered outcrop, which was sampled by Siegfried Fussenegger, is not accessible any more. The Middle Albian genus *Hoplites* spp. is common (dentatus-zone). Occasional specimens of

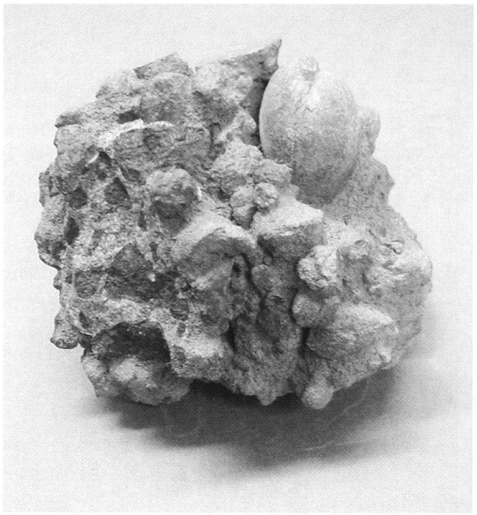

Fig. 2. Piece of rock (75 mm high) of the Plattenwald Bed with *Moutonithyris dutempleana* (d'Orbigny) and fossil debris. Inventory number P. 16577.

Hysteroceras, *Dipoloceras* and *Mortoniceras* represent the early Upper Albian inflatum-zone.

Lädtobel near Ebnit (GKR coordinates -44625 / 246060). An outcrop of the Plattenwald Bed was found approximately 0.2 km N of the church of Ebnit during construction work for a forest road. The phosphatic bed overlies bioturbated glauconitic sandstone and is succeeded by pelagic limestone of the Seewen Formation. Again strongly weathered portions provided the best fossils. *Hoplites* spp. is common (dentatus-zone). *Anahoplites intermedius* Spath and *A.* aff. *praecox* (sensu Föllmi 1989b) are characteristic of the lower loricatus-zone. One fragment of *Mortoniceras* sp. represents the inflatum-zone. However, *Douvilleiceras* ex gr. *mammillatum* (Schlotheim) is still present (one fragment). Today the outcrop is overgrown by grass and thus no longer accessible.

Achbrücke near Schwarzenberg (GKR coordinates -36475 / 251470). This outcrop on the old road from Schwarzenberg to the former railway station (approximately 1.4 km S of the church of Schwarzenberg) was sampled by Siegfried Fussenegger during construction works following a rockfall event. The 0.7 m thick, phosphatic, fossiliferous layer (representing the Plattenwald Bed) directly overlies limestone of the Barremian to Lower Aptian Schrattenkalk Formation. It is succeeded by massive, glauconitic, sandy limestone of the Aubrig Bed (Garschella Formation). This outcrop differs from all other locations by the occurrence of large specimens of *Mortoniceras* spp. and *Prohysteroceras* (*Goodhallites*) aff. *goodhalli* (J. Sowerby) (upper inflatum-zone). Other ammonites include *Puzosia* spp. and *Beudanticeras* spp.

Additional material was recovered from recently collected material by the authors at the following localities: Plattenwald, Sattelberg, and Orsanka.

3. Material and methods

As it was practically impossible to extract undestroyed brachiopods mecanically out of the hard rock, they had to be isolated by sieving from loose, weathered material, preserved as internal casts, sometimes with adhering fragments of the test (Fig. 2). The material is of poor quality, and the complete study of successive serial sections was not possible.

In favourable cases, parts of the cardinalia were preserved silicified and could be prepared by repeated treatment with 12% hydrochlorid acid, followed by rinsing with water. By this procedure the hard matrix was scrumbled to sandy grains. In this way fragments of internal structures were isolated.

All figured brachiopods are deposited at the Vorarlberger Naturschau, Dornbirn (Austria).

4. Paleontology

Terebratulids predominate with about 90% of all brachiopods. Rhynchonellids and terebratellids count for about 10% of the total. Since all brachiopods are preserved as internal moulds the following descriptions are based thereupon.

Order	Rhynchonellida Kuhn 1949
Superfamily	Pugnacoidea Williams et al. 1996
Family	Pugnacidae Rzhonsnitskaya 1956
Subfamily	Lacunosellinae Smirnova 1963
Genus	*Orbirhynchia* Pettitt 1954 [type-species: *Orbirhynchia orbignyi* Pettitt 1954]

Orbirhynchia parkinsoni Owen 1960

(Fig. 3, 4)

pars *Terebratula sulcata* Parkinson 1811: auctt.
pars 1852–1854 *Rhynchonella sulcata* (Park.); Davidson: 85–87; pl. 10, fig. 18–20 (only)
1913 *Rhynchonella sulcata* (Park.); Jacob & Fallot: 66; pl. 9, fig. 14–17
1918 *Stolmorhynchia sulcata* (Park.); Buckman: 46
1925 *Rhynchonella deluci* Pict.; Schaad: 15
1925 *Rhynchonella sulcata* Park.; Schaad: 15
1934 *Rhynchonella* cf. *sulcata* (Park.); Heim & Seitz: 198, 229, 230
1960 *Orbirhynchia parkinsoni* Owen: 250–252; pl. 5, fig. 2a–c, textfig. 1
1965 *Rhynchonella sulcata* (Park. 1811) Davidson; Alméras: 384
1974 *Orbirhynchia parkinsoni* Owen; Dieni et al.: 210–211; pl. 38, fig. 10, 11
1977 *Orbirhynchia parkinsoni* Owen; Popiel-Barczyk: 32–35; pl. 2, fig. 1–6; textfig. 5–8
1980 *Orbirhynchia parkinsoni* f. *rencurelensis* (Jac. & Fall.); Middlemiss & Owen: 204; textfig. 8
1999 *Orbirhynchia parkinsoni* Owen; Sulser: 70 (with fig.)

For the completion of synonymy compare Owen (1960) and Popiel-Barczyk (1977).

Holotype in Owen (1960), pl. 5, fig. 2a–c from the Upper Albian (Cambridge Greensand) of Cambridge, England.

Occurrence and stratigraphy

Orbirhynchia parkinsoni is reported from the Albian of England (Cambridge, Isle of Wight), France (Dépt. Isère, Savoie), central Sardinia, western Switzerland (?), Spain, and from the Lower Cenomanian of Poland (Holy Cross Mountains, region of Cracow, Tatra).

Fig. 3. *Orbirhynchia parkinsoni* Owen. Specimen from Plattenwald. Dorsal, ventral, lateral, and anterior view. 2x natural size. Inventory number P. 6271.

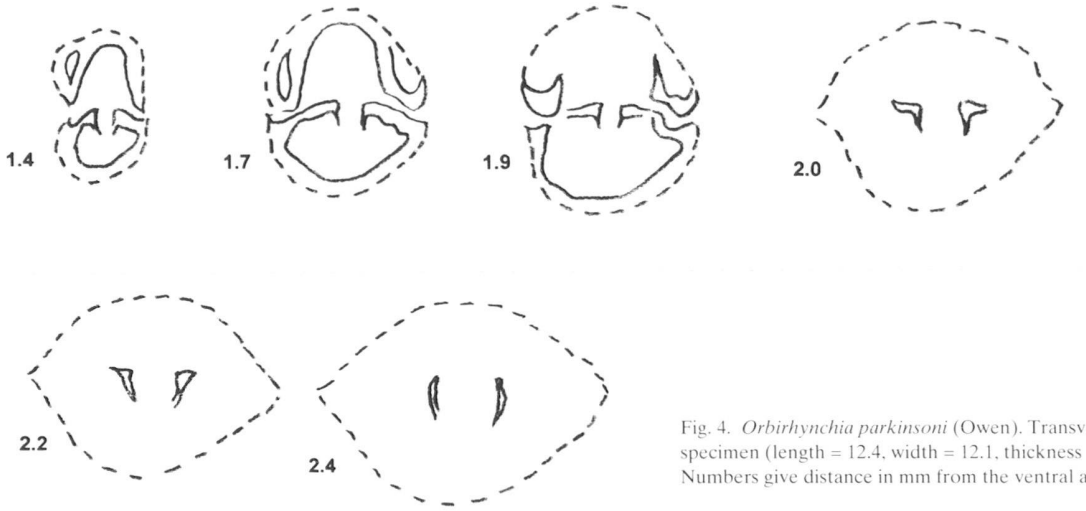

Fig. 4. *Orbirhynchia parkinsoni* (Owen). Transverse serial sections of a specimen (length = 12.4, width = 12.1, thickness = 8.5 mm) from Klaus. Numbers give distance in mm from the ventral apex. 5 × natural size.

Description

External characters

Dimensions (mm) *	Length (L)	Width (W)	Thickness (T)	W : L	T : L
Majority (80%) of specimens	10.5–15.5	12.0–17.0	6.0–9.0	1.08–1.20	0.60–0.70
Extreme values	8.3/17.3	9.4/18.3	5.4/10.5	0.97/1.32	0.53/0.74

* Number of specimens : 21 (Plattenwald: 17; Sattelberg: 3; Achbrücke: 1)

Shell oval to subtrigonal in outline. Position of greatest width at half-length or somewhat more anteriorly. Shell biconvex, curvation of dorsal valve more pronounced. Dorsal valve with scarcely perceptible median fold, somewhat more marked anteriorly. Ventral valve with recognizable sinus near the anterior commissure, widening to a regularly formed, broad uniplication, 2–4 mm high. Shell covered with 20–28 (24 on average) moderately angular, non-bifurcating costae, 4–6 in the uniplication. Beak tapering, suberect, beak-ridges ill-defined, rounded. Foramen circular, hypothyrid. Interarea short, flat. Apical angle varying between 100° and 120°, on average 110°.

Internal characters (Fig. 4)

Ventral valve: dental lamellae subparallel or slightly convergent. Hinge-teeth massive, inserted in broad dental sockets, inner and outer socket-ridges present. – Dorsal valve: cardinal process not observed. Hinge-plates wide, flat. Falcifer crura, given off dorsally, developed almost simultaneously with hinge-plates. Dorsal septum not present.

Discussion

Orbirhynchia parkinsoni was founded on „*Terebratula sulcata*" Parkinson, 1811 and has a long history which was recapitulated by Owen (1960). The allocation to the genus *Orbirhynchia* by Owen (loc. cit.) was based on the recognition of hinge plates bearing falcifer crura and the absence of a dorsal septum which are the main diagnostic features of the subfamily Lacunosellinae, represented in the Cretaceous by the single genus *Orbirhynchia*. This genus abounds in Upper Cretaceous with small and globular species, whereas *Orbirhynchia parkinsoni* has retained the trilobate shape and the relatively coarse ribs of its Jurassic ancestors, such as species of *Lacunosella* [*L. arolica* (Oppel 1865), *L. sparsicosta* (Quenstedt 1858) and others]. "Missing links" between these late Jurassic forms and *O. parkinsoni*, demonstrating some relations in external morphology might occur in the Early Cretaceous, with *Lacunosella hoheneggeri* (Suess 1859) and *Lacunosella contracta* (d'Hombres-Firmas 1842) as possible candidates (M. Sandy, personal communication).

Some other rhynchonellids occuring in the terminal Aptian and the Albian show a striking external homeomorphy with *O. parkinsoni*. *Rhynchonella deluci* Pictet 1872 was shown to have

Fig. 5. *Burrirhynchia tripartita* (Pictet). Specimen from Lädtobel. Dorsal, ventral, lateral, anterior, and posterior view. Anterior and posterior views with dorsal valve up. 3 × natural size. Inventory number P. 8935.

radulifer crura and a dorsal septum and was assigned to the genus *Cyclothyris* (Calzada 1976 and unpublished results, personal communication). The general shapes of both *Cyclothyris deluci* and *O. parkinsoni* are very similar. A clear separation may become difficult when based on external morphology only. The main discriminating characters are the denser ribs (33–46 costae) of *C. deluci*, the more accentuated convexity of the dorsal valve, the often somewhat irregular and asymmetric front-margin, the narrower apical angle (90°–100°), and the truncated anterior end.

Further cyclothyrids bearing a strong resemblance to *O. parkinsoni* are apparently restricted to the Aptian of England. They were described by Owen (loc. cit.) as species of the genus *Lamellaerhynchia* Burri, 1953. They are not further discussed here.

The specimens from the Plattenwald Bed are assigned to *Orbirhynchia parkinsoni* on the grounds of the shell characters and the presence of falcifer crura. To our knowledge this species has not been identified from the Helvetic Alps yet. They are of small size when compared to the holotype and the topotype specimens of the Cambridge area which are almost twice as large. However, they are comparable with conspecific finds in south-eastern France and east-central Sardinina. No attempt has been made to assign these forms to one of the four variations (*paludensis, paucicostata, rencurelensis, salazacensis*) which Jacob & Fallot (1913) proposed and which, in part, were taken over by Dieni et al. (1974) and Middlemiss & Owen (1980).

Rhynchonellids from diverse outcrops of the Alpine Albian were reported under different names. The poor definition of these "species" was the main reason for numerous misidentifications. Schaad (1925) and Heim & Seitz (1934) expressed their doubts about correct naming when they listed from the Plattenwald Bed: *Rh. deluci*, *Rh.* cf. *sulcata* and *Rh.* sp., respectively. Jacob & Tobler (1906) and Fichter (1934) mentioned *Rh. deluci* from the Helvetic Alps in central Switzerland, and Delamette et al. (1997) listed it from the western Helvetic. The real nature of these rhynchonellids remains to be solved.

Order	Rhynchonellida Kuhn 1949
Superfamily	Rhynchonelloidea Gray 1848
Family	Rhynchonellidae Gray 1848
Subfamily	Cyclothyridinae Makridin 1955
Genus	*Burrirhynchia* Owen 1962
	[type species: *Rhynchonella leightonensis* Lamplugh & Walker 1903]

Burrirhynchia tripartita (Pictet 1872)

(Fig. 5)

1872 *Rhynchonella tripartita* Pictet: 44–45, 54; pl. 200, fig. 4,5
1934 *Rhynchonella tripartita* Pictet; Heim & Seitz: 209
1962 "*Rhynchonella*" *tripartita* Pictet (assigned to *Burrirhynchia*); Owen: 60
1965 *Rhynchonella tripartita* Pictet 1872; Alméras: 384
1986 *Burrirhynchia tripartita* (Pictet); Lobacheva: 129–133
1999 *Burrirhynchia tripartita* (Pictet); Sulser: 87

Lectotype (designated here) in Pictet (1872, pl. 200, fig. 4a–4d), from the „Gault inférieur" of Perte-du-Rhône (Dépt. Ain, France). Repository: Museum of Natural History (Geneva, Switzerland); specimen number: A II-39-6706.

Occurrence and stratigraphy

Burrirhynchia tripartita is a rare species and, besides the type-locality, known only from the Albian of Clar (Dépt. Var, France) and Georgia in southern Russia (Kvakhadze 1973; cit. by Lobacheva 1986).

Description

External characters

Dimensions (mm) *	Length (L)	Width (W)	Thickness (T)	W : L	T : L
	9.3–17.7	8.8–22.0	7.6–14.5	0.80–1.24	0.68–0.82

*Number of specimens: 5 (Plattenwald: 1; Rotenbachalpe: 2; Gütle: 1; Tädtobel: 1)

Shell rounded-subpentagonal in outline, globose, almost equal in length and width, or spade-like and a little longer than broad. Position of greatest width variable, greatest thickness

in posterior third of length. Dorsal valve much inflated, laterally compressed. Ventral valve less convex than dorsal, with a sinus and a marked anterior geniculation, forming a right angle and giving rise to a lingual extension towards the front-margin. Wide trapezoidal or rectangular uniplication. Each valve covered with 35–50 fine costellae which, immediately before reaching the anterior edge, disappear and fuse to a pointed zig-zag-line, suggesting an antidichotomic pattern of ribs. The dorsal apex is short and tumid and pressed down to the ventral valve so that the hinge line draws a conspicuous half-circular inflexion (Fig. 5, dorsal and posterior view). After a straight, oblique section the commissure follows the geniculation of the sinus and turns in a sharp angle dorsalward (Fig. 5, lateral view). Foramen small, cyclothyrid, beak ridges rounded, apical angle 80°–90°.

Internal characters

Shortage of material did not allow the taking of serial sections. A few internal characters could be observed on internal molds: a dorsal septum, extending to about one third of valve length and persistent, subparallel dental lamellae (fig. 5, ventral and posterior view).

Discussion

Burrirhynchia tripartita may be synonymous with *Burrirhynchia leightonensis* (Lamplugh & Walker 1903) from the Aptian/Albian boundary of England, chosen as type-species of *Burrirhynchia* (Owen 1962, Owen et al. 1968). Both nominal species are much alike. They have in common some noticeable characters, such as the described type of uniplication, the course of the lateral commissure, and the unusual pattern of costellation at the anterior commissure, well illustrated by Pictet (1872, pl. 200, fig. 4c and 4e). As long as the internal structures remain unknown, they have to be treated as separate species.

Owen (1988) suggested that two other rhynchonellids may be adaptations of *Burrirhynchia leightonensis* due to changing environments. These are the Cenomanian *Burrirhynchia sigma* (Schloenbach 1867) with a sigmoidal uniplication and *Burrirhynchia devoniana* Owen 1988, at present known only from a single locality in England. The latter has a similar anterior commissure as *B. tripartita*, but is covered with more marked costae.

Burrirhynchia tripartita is the rarest brachiopod of the Plattenwald Bed. It has been reported sporadically from only few and distant localities. The few specimens we disposed of display a wide and discontinuous variation of size. This brachiopod seems to grow in variable directions during ontogenetical development. A specimen of 22.0 mm width is almost threefold as large as the smallest one (8.8 mm wide). In spite of the great span of shell size the typical characters are kept constant. It is a question, whether this behaviour is due to environmental factors, e.g. changing supply of nutrients or whether it reflects an abnormal pathological development.

Order	Terebratulida Waagen 1883
Superfamily	Terebratuloidea Gray 1840
Family	Terebratulidae Gray 1840
Subfamily	Rectithyrididae Muir-Wood 1965
Genus	*Moutonithyris* Middlemiss 1976 [type species: *Terebratula moutoniana* d'Orbigny 1849]

Moutonithyris dutempleana (d'Orbigny 1851*)

(Fig. 6 – 10)

1812	*Terebratula biplicata* J. Sowerby: 201; pl. 90, fig. 1 (only)
1847	*Terebratula Dutempliana* (sic) d'Orbigny: 93
1851	*Terebratula Dutempleana* d'Orbigny: pl. 511, fig. 1–3, 6, 7 only
1871	*Terebratula biplicata* Sow.; Quenstedt: 381, pl. 48, fig. 13, 61–67
? 1872	*Terebratula dutempleana* d'Orbigny; Pictet: 82; pl. CCV, fig. 1–5
1872	*Terebratula biplicata* Sow.; Stoliczka: 19; pl. 4, fig. 2–13
1872	*Terebratula biplicata* var. *dutempleana*; Stoliczka: 20; pl. 4, fig. 14–17
1874	*Terebratula biplicata* Sow.; Davidson: 33; pl. 5, fig. 1, 2
? 1896	*Terebratula dutempleana* d'Orbigny; Loriol: 142; pl. 5, fig. 10, 11
1903	*Terebratula biplicata* var. *dutempleana*; Lamplugh & Walker: 251; pl. 17, fig. 1a–b
1925	*Terebratula dutempleana* d'Orb.; Schaad: 15
1925	*Terebratula biplicata* Sow.; Schaad: 15
1934	*Terebratula dutempleana* d'Orbigny; Heim & Seitz: 198, 217, 221, 229, 230
1965	*Terebratula dutempleana* d'Orbigny 1847; Alméras: 385
? 1972	*Praelongithyris dutempleana* (Orb.); Smirnova: 66; pl. 5, fig. 3
1974	"*Terebratula*" *dutempleana* d'Orbigny; Dieni, Middlemiss & Owen: 185–190; pl. 33, fig. 2; text-fig. 9
1976	"*Terebratula*" *dutempleana* d'Orbigny; Gaspard: pl. 1–5
1976	*Moutonithyris dutempleana* (d'Orbigny); Middlemiss: 65
1983	*Biplicatoria ferruginea* Cooper: 174–175; pl. 21, fig. 1–6; pl. 67, fig. 12, 13, 23, 24
1983	*Biplicatoria hunstantonensis* Cooper: 176; pl. 20, fig. 21–27
1988	*Moutonithyris dutempleana* (d'Orb.); Gaspard: 197–201; pl.24, fig. 1–8; pl. 25, fig. 1–6; textfig. 78, 79
1988	*Moutonithyris dutempleana* (d'Orbigny); Owen: 122–125; pl. 10; pl. 11, fig. 4–6; pl. 18, fig. 23, 24; text-fig. 21
1999	*Moutonithyris dutempleana* (d'Orbigny); Sulser: 147 (with fig.)

For the completion of synonymy compare Dieni et al. (1974), Gaspard (1988) and Owen (1988)

*) We prefer the year 1851 as the correct publication date (instead of 1847–1851), because d'Orbigny published the plates in 1851

Lectotype, designated by Dieni et al. (1974), in J. Sowerby (1815), pl. 90, fig. 1 from the Cambridge Greensand (Albian?) of the Castle Hill, Cambridgeshire (England).

Occurrence and stratigraphy

Moutonithyris dutempleana is a widespread species in the Albian of England (Cambridge and Norfolk area) and of many localities in France. It is widely distributed in the terminal levels of the Early Cretaceous in the Alpine regions of Europe. It further occurs in the Carpathians of Poland, in northern Spain, Ibiza, and doubtfully in the Cenomanian of England and northern Germany. Possible occurrences are reported from the Albian of Madagascar, the Caucasus, the Crimea and India. Reports from the french and swiss Jura region require confirmation.

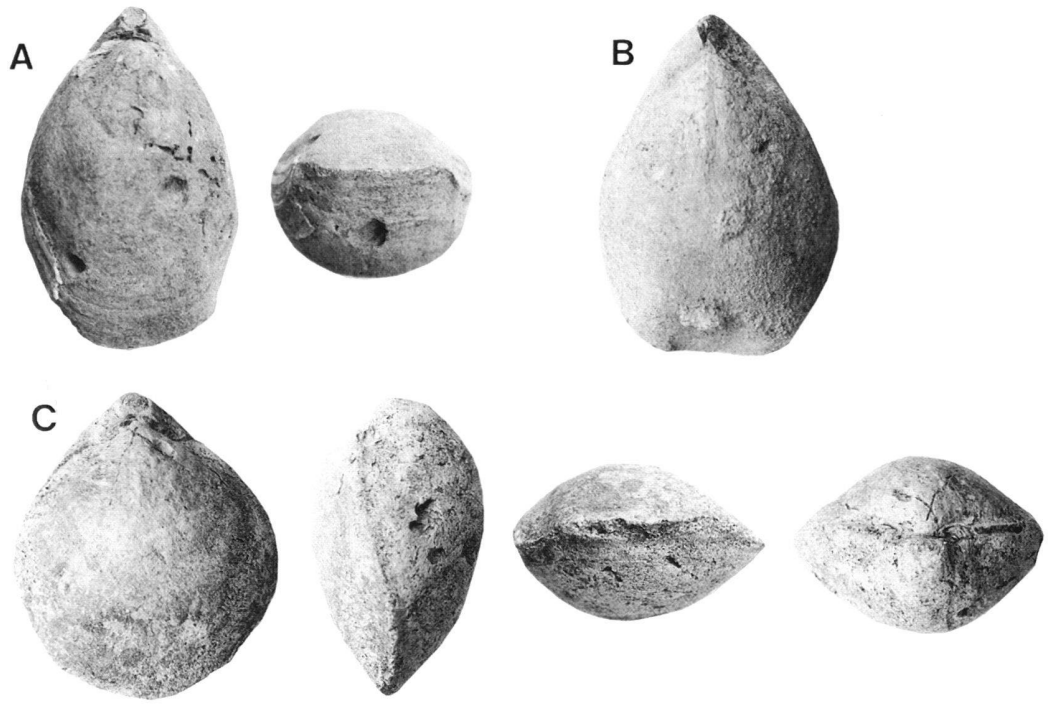

Fig. 6. *Moutonithyris dutempleana* (d'Orbigny). Morph A. 2 × natural size. A: Specimen with oval outline and weakly saddled uniplication from Plattenwald. Dorsal and anterior view. Inventory numberr P. 17123. B: Specimen with pear-like, smoothly pentagonal outline from Sattelberg. Dorsal view. Inventory number P. 17124. C: Relatively broad specimen with slightly curved lateral commissure and almost rectimarginate front, from Plattenwald. Dorsal, lateral, anterior, and posterior view. Inventory number P. 17125.

Description

External characters

Dimensions (mm) *	Length (L)	Width (W)	Thickness (T)	W : L	T : L
	15.1–25.4	12.0–21.2	8.3–16.2	0.64–0.97	0.49–0.79

*Number of specimens: over 100 (Plattenwald: 43; Sattelberg: 65; Orsanka: 23)

Shell elongated-oval or pear-like in outline, with greatest width at or just anterior of mid-length, biconvex, with maximum convexity near the apex, either on dorsal or ventral valve. Anterior commissure variable: uniplicate to more or less biplicate, with either none or very low median depression, or distinctly sulciplicate to episulcate. Lateral commissure arched in ventral direction. Beak sub-erect to erect. Foramen large, labiate. Deltidium not visible. Apical angle 60–80°.

Two variants, designated as morph A and B, can be distinguished :

Morph A (Fig. 6) is almost rectimarginate or displays a very flat uniplicate broad anterior elevation of not more than 1–2 mm. In rare specimens a tendency towards a weak biplication can be observed. The lateral commissure is nearly straight.

Morph B (Fig. 7) has a sulciplicate or episulcate anterior commissure with distinct plicae and a pronounced median sinus of 2–5 mm depth. The lateral commissure is distinctly curved. Impressions of the vascular system are occasionally visible (Fig. 7A, dorsal view), and, also rarely, an accumulation of growth-lines.

Internal characters (Fig. 8)

The internal morphology could be studied only partially by transverse sections. Some insight was obtained by isolated parts of the brachidium (Fig. 8, left). A distinct cardinal process is flanked by deep dental sockets (Fig. 8, right). Hinge plates horizontal, becoming convex later on, keeled at the inner edge. Crural processes not observed. Loop situated at about one third of shells length, partially exposed, probably narrow. No difference of internal characters between morph A and morph B was observed.

Discussion

The gradual change of Sowerby's species name „*biplicata*" to the now valid „*dutempleana*" is illustrated in the long list of synonyms. In the past this was a controversal species and the subject of many misinterpretations. After the internal structures had been studied in specimens of the type region, first by Middlemiss (in Dieni et al. 1974) and later by Gaspard (1988)

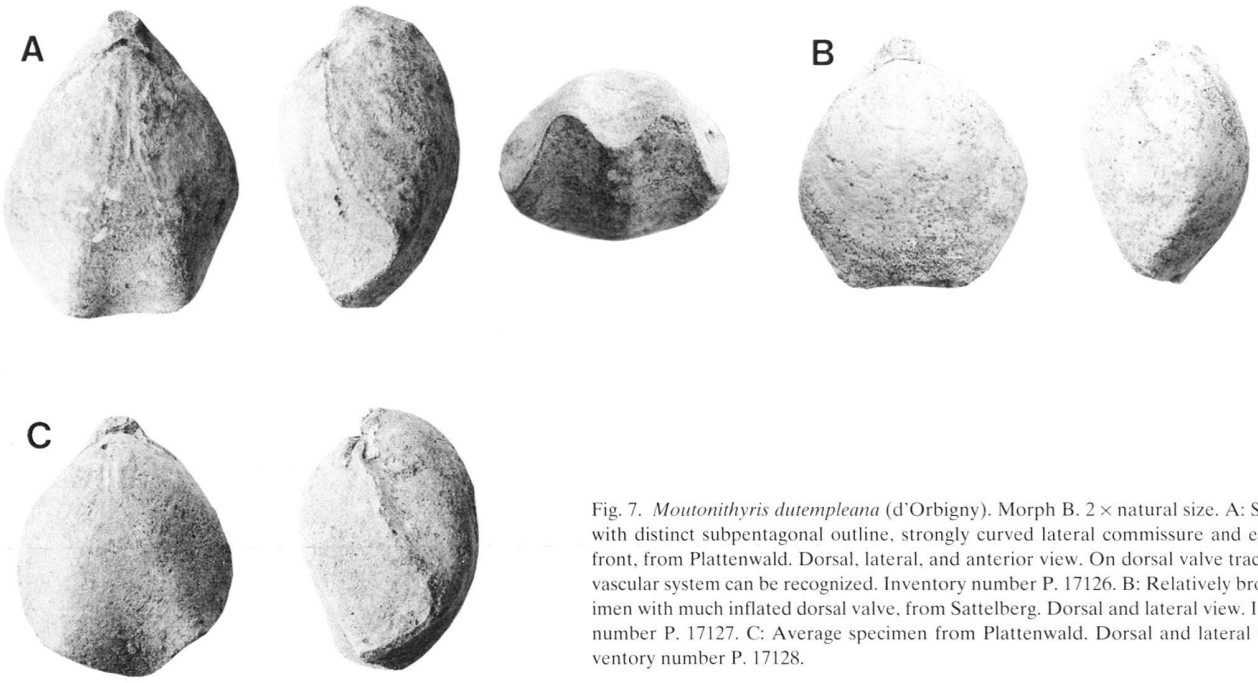

Fig. 7. *Moutonithyris dutempleana* (d'Orbigny). Morph B. 2 × natural size. A: Specimen with distinct subpentagonal outline, strongly curved lateral commissure and episulcate front, from Plattenwald. Dorsal, lateral, and anterior view. On dorsal valve traces of the vascular system can be recognized. Inventory number P. 17126. B: Relatively broad specimen with much inflated dorsal valve, from Sattelberg. Dorsal and lateral view. Inventory number P. 17127. C: Average specimen from Plattenwald. Dorsal and lateral view. Inventory number P. 17128.

and Owen (1988), *Terebratula dutempleana* was assigned to the genus *Moutonithyris*. Related species could then be discriminated and partly assigned to pre-existing genera such as *Praelongithyris* and *Cyrtothyris*. The important diagnostic character of *Moutonithyris*, the hammer-shaped hinge plates, was well recognized in the Plattenwald specimens.

In many localities of the Alpine Albian forms ascribed to *Moutonithyris dutempleana* occur in phosphatic and siliciclastic beds. Internal structures are mostly destroyed, and identification has to be based on external morphology alone. Its presence elsewhere in the Helvetic Alps was reported by Renevier (1854), Moesch (1878, 1881, 1894), Jacob & Tobler (1906), Oberholzer (1933), Fichter (1934), and other authors. However, paleontological confirmation remains to be done for these localities. In cases of undated stratigraphy the risk of confusion with *Moutonithyris moutoniana* (d'Orbigny) which does not reach the Albian stage, is possible. Normally, *M. moutoniana* displays a more circular outline and is less biplicate, but in unusual large individuals which show a tendency to become elongate and to develop a distinct biplication, both species look much the same. *M. moutoniana* colonized the marginal areas of the Tethys during the whole Early Cretaceous. It is a rather common element in the Aptian of the Helvetic, and it seems likely that *M. dutempleana* became its successor by replacement (Middlemiss 1973, 1979).

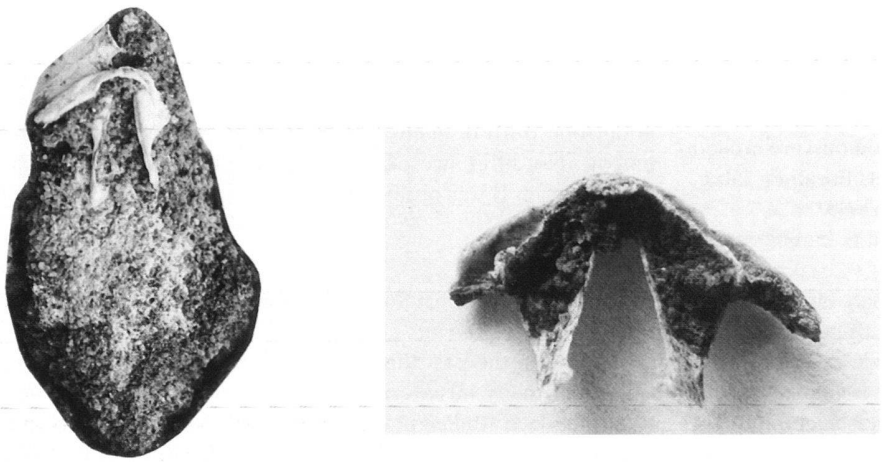

Fig. 8. *Moutonithyris dutempleana* (d'Orbigny). Specimens from Plattenwald. Left: Morph A. Almost complete brachidium with parts of the transverse band, exposed from dorsal side by acid treatment. Convex crura with distinct inner edges, a character of *Moutonithyris*. 4 × natural size. Right: Morph B. Ventral view of deep and long dental sockets enclosing a porous cardinal process. The distal parts of the crura and the transverse band are not preserved. 6 × natural size.

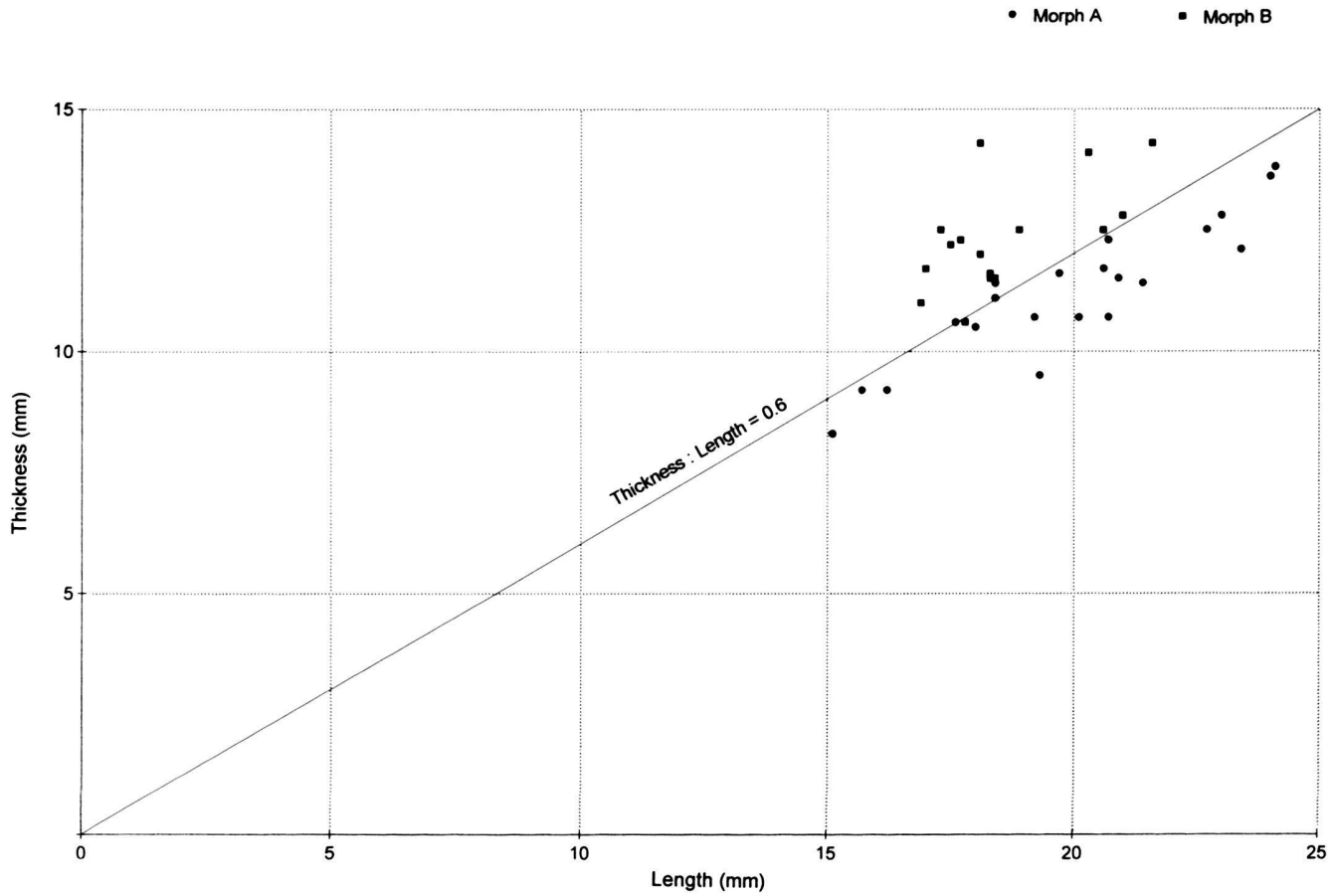

Fig. 9. Population of *Moutonithyris dutempleana* (d'Orbigny) from Plattenwald. Shell length and thickness of 21 specimens of morph A (thickness:length ratio = 0.49–0.62) and 16 specimens of morph B (thickness:length ratio = 0.60–0.79).

External and internal morphology leave no doubt that the populations of the Plattenwald Bed can be assigned to *M. dutempleana*. The multitude of specimens shows a shell length of 15–22 mm. Larger individuals were found at Orsanka. In all sampled localities *M. dutempleana* occurs in two different forms, named morph A und morph B. Their internal structures are identical and their distribution is approximately 50:50. We think that both forms should be considered morphotypes of one species, since practically no transient forms can be observed and so a clear-cut (sexual?) dimorphism results. The different shell shapes of morph A and B can be discriminated by biometrical means. Specimens of morph B display a thickness:length ratio which is always greater than 0.6 whereas those of morph A are below this (Fig. 9). Otherwise the width:length ratio shows about a similar distribution for both morphs, and it is not possible to tell them apart (Fig. 10).

A brachiopod, very closely related to *M. dutempleana*, was named by J. de C. Sowerby (1825) *Terebratula obtusa*, associated with *dutempleana* in the Albian Greensand of the Cambridge area. This companionship was registrated at many other places where *M. dutempleana* occurs. Davidson (1852–54) namely distinguished both *dutempleana* and *obtusa*, but united them in his synonymy of *Terebratula biplicata* (now *Moutonithyris dutempleana*). The internal structures of both „species" are identical. Gaspard (1988, 1997) treated both nominal taxa as different species and maintained that *Terebratula* (*Moutonithyris*) *obtusa* is confined to the Cambridge Greensand. We do not opt for either interpretation. However, in an informal manner morph A might be called the „*obtusa* type" and morph B the „*dutempleana* type", because these affinities are quite obvious.

Superfamily	Terebratelloidea King 1850
Family	Dallinidae Beecher 1893
Subfamily	Gemmarculinae Elliott 1947
Genus	*Gemmarcula* Elliott 1947 [type species: *Terebratula truncata* J. de C. Sowerby 1826]

***Gemmarcula ? plattenwaldensis* sp. nov.**

(Fig. 11, 12)

Terebratula cf. *moreana* sensu Seitz: *in schedulis*.

Derivation of name: *plattenwaldensis* – according to the stratotype locality of the „Plattenwald-Schicht".

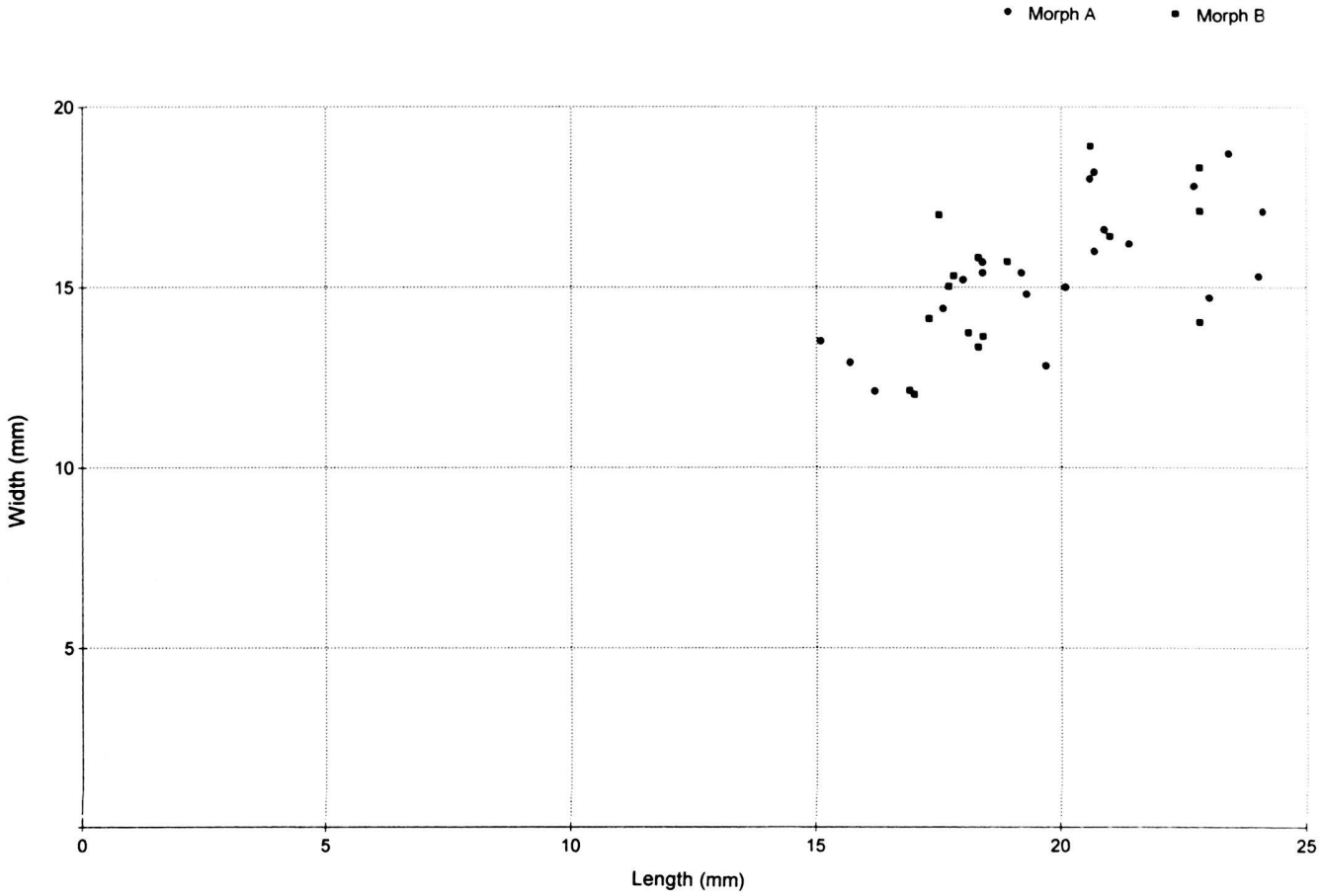

Fig. 10. Same population of *Moutonithyris dutempleana* (d'Orbigny) as in fig. 9. Shell length and width of 21 specimens of morph A (width:length ratio = 0.64–0.89) and 16 specimens of morph B (width:length ratio = 0.69– 0.97).

Holotype in Fig. 11A, from the Plattenwald Bed (Albian). Specimen number: P. 10318. Type locality: Plattenwald near Klaus (Vorarlberg, Austria). Paratype in Fig. 11B, same locality. Specimen number: P. 11923.

Description

External characters

Dimensions (mm) *	Length (L)	Width (W)	Thickness (T)	W : L	T : L
	9.9–13.3	9.5–12.7	8.0–10.0	0.94–1.01	0.62–0.84

*Number of specimens: 9 (Plattenwald: 6; Sattelberg: 1; Gopfberg: 2)

Shell biconvex, stout, rounded-pentagonal to subcircular in outline, oval to subcircular in profile, length and width equal, greatest width and greatest thickness in the middle of the shell. Dorsal valve with three broad rounded folds and deeply furrowed spaces in between, often with distinct muscle scars. Ventral valve with two corresponding strong folds on each side of a deeply incised sinus. Occasionally with a thickened area near the lateral margins. Test (when preserved) covered with about 24 radiating, intercalate costellae. Anterior commissure antiplicate. Beak stout, suberect, truncated by a large foramen. Beak-ridges rounded, hinge-line narrow, interarea triangular. Apical angle 80–90°.

Internal characters (Fig. 12)

A short sequence of sections revealed a broad transverse band (Fig. 12, section 5.2 mm). Some further details of the internal structures were detected on weathered internal moulds: a long dorsal septum, extending to at least 75% of total shell length, and muscle scars (diductors) on the posterior half of the valve (compare Fig. 11A, dorsal valve).

Discussion

Only two specimens were available for sectioning. The study of the internal morphology is therefore incomplete, but further details were detected on the surface of the internal moulds: a long loop and a high and long dorsal septum, extending to

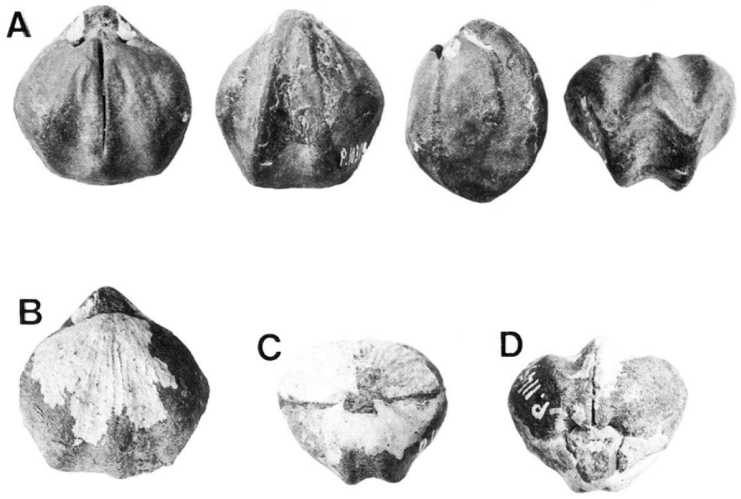

Fig. 11. *Gemmarcula*? *plattenwaldensis* sp. nov. 2 × natural size. A: Holotype from Plattenwald. Dorsal, ventral, lateral, and anterior view. Anterior view with dorsal valve up. On the dorsal valve the muscle scars are visible. Inventory number P. 10318. B: Specimen from Plattenwald. Dorsal valve with preserved fragments of ribbed test. Inventory number P. 11923. C: Specimen from Gopfberg. Posterior view. Inventory number P. 11451. D: Specimen from Gopfberg. Posterior view, showing long septum and dental lamellae. Inventory number P. 11450.

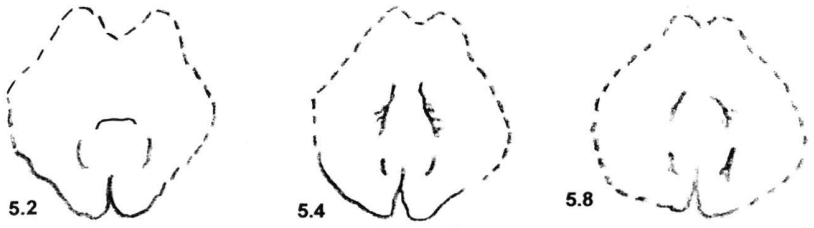

Fig. 12. *Gemmarcula*? *plattenwaldensis* sp. nov. Transverse serial sections of a specimen (length = 10.5 mm, width = 10.1 mm, thickness = 9.0 mm) from Plattenwald. Numbers give distance in mm from the posterior end. 3 × nat. size.

about 75% of total shell length. There is scarcely any doubt that these brachiopods are terebratellids, but a satisfactory identification on the grounds of relevant known species was not possible. The species of the Plattenwald Bed under study was named *plattenwaldensis* sp. nov.

O. Seitz compared these terebratellids with *Terebratula* cf. *moreana* (collection labels) without giving an authorship for this taxon. *Terebratula moreana* d'Orbigny (1851, pl. 506, fig. 13–16) shows affinities to *T. reticulata* Schlotheim and *T. puscheana* Roemer both of which Owen (1977) synonymized with his *Oblongarcula alemannica*, a Hauterivian species of the Hilsconglomerat in northern Germany and in France (Dépt. Haute-Marne). A common character of these forms are three broad folds on the dorsal valve which are seen also on the Plattenwald specimens, but their general shell morphology is distinctly different.

A Cenomanian species of northern Germany, *Megerleïa* (?) *hercynica* Schloenbach 1867, assigned to *Gemmarcula* Elliott 1947 by Owen (loc. cit.), and the supposedly synonymous *Terebratella kurskensis* Hofmann 1869 differ from *plattenwaldensis* in having seven or rarely five dorsal folds and a much shorter septum. *Arenaciarcula acuticosta* Owen 1977 of the Lower Albian of England (Bedfordshire), originally described by Lamplugh & Walker (1903) as Schloenbach's species mentioned above, and „*Eudesia*" *tekedgikensis* Smirnova 1972 from the Upper Albian of Turkmenistan differ from the Plattenwald individuals by their pattern of costae and the fan-shaped outline.

A strong evidence to assign the species *plattenwaldensis* either to the genus *Gemmarcula* Elliott 1947 or *Arenaciarcula* Elliott 1959 is lacking. The broad transverse band may be indicative for both genera. Therefore an open nomenclature is used.

Other brachiopods (Fig. 13)

The Plattenwald Bed furnished some further brachiopods in very small number. A reliable description is not possible, but they are mentioned and figured in order to complete the faunal spectrum of the brachiopod assemblage. The one, a thick globular brachiopod with a massive, much incurved umbo and a well visible mark of the dorsal septum on the surface of the mould has some affinity to representatives of *Kingena* (Fig. 13A). Other forms like the preceding one are less thick and fan-shaped, with a maximum width shifted to the anterior line (Fig. 13B).

5. Conclusions

The brachiopods of the Plattenwald Bed are a minor and accessory element in a fauna which is clearly dominated by ammonites. These indicate a time span which reaches from the

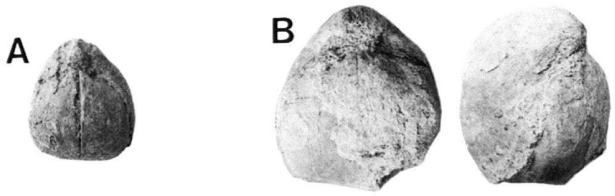

Fig. 13. Unidentified brachiopods from Plattenwald. 2 × natural size. A: Dorsal valve with very long septum. Inventory number P. 5885. B: Dorsal and lateral view of a more globular specimen. Collection H. S.

uppermost Aptian to the top of the Albian (Föllmi 1989b). This is in agreement with the age of the brachiopods, as far as their life span is known. *Burrirhynchia tripartita* is known hitherto only from the tardefurcata-zone and thus represents the Lower Albian. *Moutonithyris dutempleana* and *Orbirhynchia parkinsoni* are characteristic for the Upper Albian and basal Cenomanian. The Early and terminal Albian are well documentated by the brachiopods.

When we look at the brachiopod assemblage in the Tethyan (Alpine) and Subtethyan (Jura) domains, a parallelism in the evolution of Early Cretaceous stages is obvious (Gaspard 1999). One of the reasons is the development of similar facies in the „Schrattenkalk" and in the Urgonian, culminating and widespread in the Barremian and Aptian. In the Albian the brachiopod communities change. They developed in highly condensed, geographically limited, spot-like areas and with a very slow sedimentation rate. As a whole, the Plattenwald brachiopods can be characterized as the remains of a small, adaptive group of generalists with affinities to a fauna of the boreal type.

In the Plattenwald Bed a normal oxygen supply with a tendency to eutrophism is assumed (Föllmi, personal communication).The brachiopods are generally of small size, but in one locality (Orsanka) larger individuals of *Moutonithyris dutempleana* coexist with small ones. In view of the long time during which the Plattenwald Bed accumulated, one can argue that brachiopods of different size did not live simultaneously, but reflect periods of more or less favorable conditions of life.

Gemmarcula ? *plattenwaldensis* sp. nov. shows a remarkable morphological steadiness with regard to size, shell ornament and shape. This low variability may reflect a life in protected niches. The species is rare yet, perhaps an indication that favorable conditions did probably not last for long.

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