The Mesozoic scleractinian genus Adelocoenia (Stylinidae) and its Jurassic species

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Abstract: The genus Adelocoenia ORBIGNY, 1849, is revised and a neotype is designated for its type species Astrea castellum MICHELIN, 1844. For various reasons that lie in the taxonomic history of scleractinian corals, it has become a difficult task to reliably assign Mesozoic corals having the combined features of plocoid corallite integration and the absence of a columella. Therefore, many such genera are in need of revision, one of which is Adelocoenia. In addition to the revision of the type species, Jurassic species grouped within Adelocoenia are revised using type material when it was possible. Many new synonymies are proposed mainly on characters such as symmetry and dimensions of skeletal features. Another consequence is that most species previously grouped with Pseudocoenia ORBIGNY are transferred to Adelocoenia. Furthermore, we present a clarified view of the paleogeographical and stratigraphical distributional patterns of the genus Adelocoenia, according to which Adelocoenia had its first appearance during the Early Jurassic, represented by a single specimen known from the Sinemurian of France. Subsequently, this genus had a significant increase in both distribution and diversity during the Middle Jurassic. The pinnacle of its success followed in the Late Jurassic during which Adelocoenia had its greatest morphological disparity and taxonomical diversity, and its largest geographical distribution. The genus survived in the Cretaceous record. Throughout its history, Adelocoenia predominantly occurred in inner platform environments that were located in low latitudes.

Key-words: • taxonomy; • nomenclature; • coral; • Scleractinia; • Mesozoic; • Jurassic; • paleogeography

Résumé : Adelocoenia (Stylinidae), genre scléractinien mésozoïque, et ses espèces jurassi ques.- Le genre Adelocoenia Orbigny, 1849, est révisé et un néotype est désigné pour son espèce type Astrea castellum Michelin, 1844. Pour diverses raisons qui tiennent à l’histoire taxinomique des coraux scléractinaires, il est devenu difficile d’identifier de manière fiable des coraux mésozoïques combinant les caractéristiques d’une structure coloniale plocoid et une absence de columelle. C’est pourquoi de tels genres ont besoin d’être révisés, et parmi eux, Adelocoenia. En complément à la révision de l’espèce type, les espèces jurassi ques regroupées au sein d’Adelocoenia sont révisées en utilisant le matériel type lorsque cela était possible. De nombreuses nouvelles synonymies sont proposées, fondées principalement sur des caractères tels que la symétrie et les dimensions squelettiques. Une autre conséquence est que la plupart des espèces précédemment groupées au sein de Pseudocoenia Orbigny sont transférées vers Adelocoenia. En outre, nous présentons une vue clarifiée des distributions paléogéographiques et stratigraphiques du genre Adelocoenia, selon laquelle ce genre a fait sa première apparition au cours du Jurassique inférieur, représenté par un seul spécimen connu du Sinémurien de France. Par la suite, ce genre a connu une augmentation significative de sa répartition et de sa diversité au cours du Dogger. L’apogée de son succès a suivi au Jurassique supérieur au cours duquel Adelocoenia a montré ses plus grandes disparité morphologique et diversité taxinomique, ainsi que son aire de répartition la plus vaste. Le genre a survécu dans l’enregistrement fossile du Crétacé. Tout au long de son histoire, Adelocoenia a principalement vécu dans des environnements de plates-formes intenses de basses latitudes.

Mots-clés : 
- taxinomie ; 
- nomenclature ; 
- coraux ; 
- Scleractinia ; 
- Mésozoïque ; 
- Jurassique ; 
- paléogéographie

1. Introduction

Confusion reigns about the names that have been applied to plocoid Mesozoic corals. In this paper we are dealing especially with the plocoid scleractinian coral genera lacking a columella, specifically Pseudocoenia and Adelocoenia. In many works, the genus concept applied to Pseudocoenia is that proposed by Roniewicz (1966, p. 179). However, although it is an excellent description, it is unfortunately based on an erroneous type species designation. In order to resolve the issue, in a case submitted to the ICZN, Löser (2007, case 3386) proposed the conservation of usage of Pseudocoenia. Unfortunately, the proposal was rejected (Opinion 2321, March 2013), leaving the Pseudocoenia issue unresolved. For this reason, and because this genus plays a key role in the revision of the upcoming Treatise on Invertebrate Palaeontology (for progress see http://www.corallosphere.org/ under Cairns et al., 2010), we propose another solution by establishing a clarifying taxonomic concept of the senior synonym genus Adelocoenia Orbigny, 1849, which was erected one year before Pseudocoenia Orbigny, 1850.

Plocoid Jurassic scleractinian corals have been reported from a large number of localities (see for instance Martin-Garin et al., 2012). They form a diverse group that has been for one and a half centuries the subject of most controversial discussions with regard to the variation of certain skeletal structures. The question as to whether the axial structure called a columella was a labile or stable character was discussed as early as in the mid 19th century between Orbigny (1849, p. 7; 1850) and Milne Edwards (1857, p. 234-235). Modern authors generally consider that, in these plocoid genera, the presence or absence of a columella is a character that is stable enough to be genus-defining (e.g., Roniewicz, 1966; Zaman, 2012). Consequently, in modern taxonomic usage, genera such as Stylinia Lamarck, 1816, Heliohocenia Étallon, 1859, and their junior synonyms are distinguished by the presence of a columella from genera such as Adelocoenia, Solenocenia Roniewicz & Gill, 1976, Cyathophora Michelin, 1843, and their junior synonyms. Figure 1 shows the differences between these genera which are the basis for the synonymies adopted in the current paper. Excluded from the current work is the rhipidogyrid genus Bracthelia Beaucamps & Beauvais, 1975 (including its junior synonym Starostinia Doweld, 2014 [= replacement name for Ironella Starostina & Krasnov, 1970, non Ironella Cobb, 1920]), which is characterized by a great variability of its axial structures, ranging from the absence of a columella to the presence of different columellar types.

2. Characters and their variations

Columella

The variability of the columella has been discussed for a long time. Orbigny (1849, p. 7; 1850) considered the presence/absence of a columella as a stable character that can be used to distinguish many plocoid forms. In contrast, Milne Edwards and Haime (1857, p. 234-235) considered this character to be of no significant value and grouped many species, often with doubt, within Stylinia (see for instance Milne Edwards & Haime, 1851b, p. 58-62; 1857, p. 234-249). While the latter interpretation was followed by some authors (e.g., Thomas, 1935; Wells, 1956), other coral workers took into consideration the possibility that, in some forms, in a small number of corallites a columella might not be preserved and that, in other forms, in transverse section, a convex tabula can mimic a styliform columella due to
Figure 1: Comparison between macroscopic characters of key Mesozoic plocoid coral genera.

poor preservation (RALPH & SQUIRES, 1962; BEAUV-VAIS, 1964; TURNŠEK & POLŠAK, 1978; LAUXMANN, 1991; BARON-SZABÓ, 1993, 1997). Therefore, this character has been interpreted by subsequent authors as stable enough to be used as a genus-level character.

Wall

ALLOITEAU (1958, p. 109) and BEAUVAIL (1964, p. 118, 123) used the nature of the wall as the basis for generic distinctions, such as both the presence of a septothecal wall in Pseudocoenia and the occurrence of a parathecal wall in Cryptocoenia ORBIGNY, 1849, and Adelocoenia. Inte-
restingly, BEAUVAIS described forms that have mixed wall structures. One example is "Pseudocoenia subloevis" which she described as having both a septotheca and a stereozone (BEAUVAIS, 1964, p. 123). With regard to the variability of the wall in the genera concerned, the key feature lies in the occurrence of costae that do not have a septal counterpart (exocostae of ZAMAN, 2012, p. 53), which, consequently, leaves less space for the paratheca. Conversely, when the number of septa is equal to the number of costae, a wider space is left for the paratheca. Neighboring septa are connected in continuity with the septal thickening deposits.

**Coenosteum**

The development of costae varies within the coenosteum depending on their growth stage. As in other plocoid stylinid corals, the peritheca in *Adelocoenia* has a biphasic development whereby phases of dissepimental growth follow phases of costal growth. These developmental phases are not synchronous across the same colony.

**Endotheca**

The endotheca seems to be a defining character in several genera. *Adelocoenia* differs from *Solenocoenia* in the structure of the endotheca. In *Adelocoenia* it is tabuloid. In *Solenocoenia*, a two-zoned endotheca is present that consists of an external zone made of small dissepiments and a central zone formed by tabuloid dissepiments. *Cyathophora* was believed to be characterized by complete tabulae as well; however, this is not completely true as reported in recent works (PANDEY et al., 2002, Figs. 3-5; ZAMAN & LHATHILIERE, 2014, p. 199; MORYCOWA & RONIEWICZ, 2016, p. 5). In *Adelocoenia*, some incomplete tabulae occur in the endotheca.

**Costae**

In *Adelocoenia*, the relationship of the number of costae to the number of septa is a species-defining characteristic. In some species, the number of costae is equal to the number of septa, whereas in others due to the presence of exocostae, the number of costae is twice the number of the septa. Exocostae were defined as a subcategory of costae characterized by the absence of a septal counterpart (ZAMAN, 2012). Regarding their confluence, there exists a rather wide variability as the occurrence of the "subconfluent" character state (= state between "confluent" and "non confluent") clearly indicates a great variability.

**Auriculae and granulae**

The development of auriculae is variable among plocoid corals. The terminology used for their description is based on the initial work of GILL (1977), which was later completed by ZAMAN and LHATHILIERE (2011). Figure 2 gives the distinctive characters of the main types of auriculae. Size and shape as well as frequency of their development vary in each genus. In *Cyathophora*, auriculae are absent. In *Solenocoenia*, they are developed most feebly, whereas in *Brachthelia* they are abundant and large. According to increasing development of auriculae, the genera dealt with in the current work form the succession *Solenocoenia-Adelocoenia-Stylina-Heliocoenia-Brachthelia*. In the first two genera, the auriculae are both hastiform to koutaliform and poorly developed. In *Stylina*, koutaliform auriculae are dominant. In *Heliocoenia*, koutaliform auriculae are dominant as well but, in addition, they are more frequently associated with the development of "tigelles" (= small rods that stand off of the auriculae, connecting septa with the columella; as defined by GILL, 1977). Flabelliform auriculae are dominant in *Brachthelia*.

With regard to the general development of septal ornamentation, the genera follow the same pattern: from most weakly developed in *Solenocoenia* to most elaborately developed in *Brachthelia*.

**Geometry of the septal apparatus**

The geometry of the septal apparatus varies in different taxa according to two distinct criteria. One is characterized by either the predominance of bilateral symmetry (*Heliocoenia, Bilaterocoenia MORYCOWA, 1974*) or axial symmetry (*Stylina, Adelocoenia, Solenocoenia, Cyathophora*). The other criterion is the order of symmetry of the coralite axis, septa are generally arranged in symmetries of 6, 8 and 10. This is true for plocoid genera with or without a columella, but also occurs in phaceloid genera of the family Stylinidae ORBIGNY, 1851. Other types of symmetrical developments are rather rare and found only in a few cases, for instance *Adelocoenia novemseptata* (RONIEWICZ, 1966), known from a single nonameral specimen, or *Pseudocoenia breviseptata* RONIEWICZ, 1976, which is generally octameral but can have corallites with hexameral or heptameral septal developments. In addition, it seems that in some species with octameral septal development, hexameral or tetrameral arrangements occur in early septal developmental stages (ZAMAN, 2012, Pl. XXIV).
Shape of interseptal chambers

Zaman (2012) distinguished several morphological types of interseptal chambers: triangular, box-like ("en boîte"), and round. He considered that this character could be significant at the species rank. Based on the observation of these patterns and their variability, we rather suggest that these shapes are related to the capacity of corals to produce their skeletal carbonate. Angular morphologies (triangular and box-like) are related to low production rates and round chambers are rather linked to high production rates. These parameters can be driven by ontogeny and environmental conditions. The same kind of ecophenotypic variations are observed today in transplanted Montastrea annularis (Ellis & Solander, 1786) (Budd Foster, 1980, Fig. 3).

Canals

The presence of canals has been considered as one of the synapomorphic characters of species of Solenocoenia (Roniewicz, 1976, p. 112). Roniewicz (2008, p. 131), followed by Zaman (2012, tabl. 48), even considered this character to be of such great importance among scleractinian corals that it justified the establishing of a new family, the Solenocoeniidae. These canals have been described in detail by Roniewicz (1976, p. 112). Nevertheless, two issues need to be taken into further consideration. First, the well-known species S. sexradiata (Goldfuss, 1826), which was initially grouped with the genus Solenocoenia, has no canals. Lauxmann (1991, p. 116) and Barron-Szaro (2014, p. 79) observed that in specimens of S. sexradiata from the type locality (Upper Jurassic of southern Germany) the distribution of canals was much too irregular within the same colony and also among different colonies of this species to justify that this feature could be used as a taxonomic criterion. Our observations confirm the latter conclusion. It seems that these canals are present only in some particular species of plocoid corals, for instance we never find them in Adelocoenia which has exocostae. Consequently, we prefer to interpret these canals as the result of symbiotic or commensal relationships between Solenocoenia-like corals and an unknown soft-bodied organism. This conclusion is based on the fact that, because the canals are filled with dissepiments, they cannot be considered to be the result of post-mortem bioerosion.

The whole set of characters described above confirms the placement of Adelocoenia within the family Stylinidae Orbigny, 1851. The most obvious synapomorphies are the septal microstructure and the presence of auriculae. Furthermore, we see no more reason to place Solenocoenia in a separate family as it has been proposed (Roniewicz, 2008) and no reason to place together Solenocoenia and Adelocoenia in a separate family Solenocoeniidae without synapomorphic characters as proposed by Löser (2016).

3. Material, methods and abbreviations

The material included in the current studies is housed at the following institutions:
- CPUN Collections Paléontologiques Universitaires de Nancy, Vandoeuvre-lès-Nancy (France),
- FSL Université Claude Bernard Lyon1 (France),
- Geological Museum of Cairo (Egypt),
- IGPS Institute of Geology and Paleontology, Sendai/ Tohoku University Museum (Japan),
- IPB Institut für Paläontologie Bonn (Germany),
- LPB (FGGUB) Laboratoire of Paleontology, Faculty of Geology and Geography, University of Bucharest (Romania),
- MG Museu Geológico Lisboa (Portugal),
- MGL Musée de Géologie, Lausanne (Switzerland),
- MHNG Musée d’Histoire naturelle de Genève (Switzerland),
- MJSN Musée Jurassien des Sciences Naturelles, Porrentruy (Switzerland),
- MNHN Muséum national d’Histoire naturelle, Paris (France),
- MSNUP Museo di Storia Naturale, Universita di Pisa, Calci (Italy),
- NHMUK (formerly BM [NH]) Natural History Museum, London (UK),
- NNMW Naturhistorisches Museum in Wien (Austria),
- NIGP Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (China),
- NMB Naturhistorisches Museum in Basel (Switzerland),
- NMME Naturhistorisches Museum Bern (Switzerland),
- PU Museo di Geologia e Paleontologia dell’ Universita di Torino (Italy),
- RUC Rajasthan University Jaipur (India),
- SAZU Paleontological Institute of the Slovene Academy of Sciences and Arts, Ljubljana (Slovenia),
- CAMSM Sedgwick Museum Cambridge (UK),
- SMF Forschungsinstitut Senckenberg, Senckenberg Museum, Frankfurt/Main (Germany),
- SMNS Staatliches Museum für Naturkunde Stuttgart (Germany),
- SNSB-BSPG Bayerische Staatssammlung für Paläontologie und Geologie, Munich (Germany),
- ÚÚG Ústřední Ústav Geologického (Geological Institute), University of Prague (Czech Republic),
- ZPAL Polish Academy of Sciences, Institut of Paleobiology, Warsaw (Poland).
For open nomenclature we follow the recommendations by Bengston (1988, p. 226):
- Genus? = genus uncertain;
- Genus species? = species uncertain.

Abbreviations
* = first description of taxon.
v = the material has been studied by at least one of the authors.
p = partial synonymy.

Dimensions:
D = diameter of calices;
c-c = distance of corallite centers;
Ns = number of septa;
Nc = number of costae;
De = density of endothecal dissepiments.

Septal formula of 6S1 + 6S2 + nS3 means: 6 septa of the first size order, 6 septa of the second size order, and a variable number of septa of the third size order.

4. The genus Adelocoenia and its type species

Adelocoenia Orbigny, 1849, p. 7.

Originally included species: only Astrea castellum Michelín, 1844.

Type species: Astrea castellum Michelín, 1844, p. 118, Pl. 27, fig. 4, by original monotypy.

Short diagnosis: Plocoid Stylinidae without columella, one-zoned endotheca and a weak development of ornamentation and auriculae.

Synonymy: We propose here that the vast majority of the species assigned to Pseudocoenia based on the usage of the genus as defined by Roniewicz (1966) closely correspond to the taxonomic concept of Adelocoenia. The present concept of Adelocoenia is also in accordance with recent usages of the term by Löser (2016, p. 151) and Barón-Szabo (2018, p. 76). The name Pseudocoenia itself as defined by the type specimen of its type species is not a synonym of Adelocoenia (see remarks under the description of "Pseudocoenia bernardina"). In addition to the species formerly grouped with Pseudocoenia, the genus Elasmophora Alloiteau, 1958, is also considered as a junior synonym of Adelocoenia. Furthermore, a significant number of species which were originally grouped with the genus Cryptocoenia by Koby (1881) are also transferred here to Adelocoenia. However, the type species of Cryptocoenia (Astrea alveolata Goldfuss, 1826) itself is placed with Cyathophora.

Status: available and valid.

Adelocoenia castellum (Michelin, 1844) (Fig. 3)

Originally included specimens: Michelin mentioned the two collections of Michelin and Moreau, which included syntypes from the Oxfordian (Upper Jurassic) of three localities in France: Bay-Bel (Ardennes), Goussaincourt (Meuse), and Sampigny (Meuse). The number of samples was not specified.

Type material: original syntypes at MNHN are lost. We designate herein a neotype. It is MNHN. F.M00001 (Michelin coll.) from the Oxfordian of Stenay, Ardennes, France.

Type locality: Oxfordian of Stenay, Ardennes, France.

Remarks: The concept of Adelocoenia by Alloiteau was based on a toptype from Sampigny he selected from the collection of Orbigny no. 4452 - MNHN.F.A09413. In 1966, Roniewicz erroneously considered this specimen as a neotype.

In order to clarify the taxonomic position of Adelocoenia, we see no solution other than to carry out a correct designation of a valid neotype. In complying with the ICZN rules (ICZN Art. 75.3.1-7), we clarify the following issues.

1. We affirm that the designation of a neotype is necessary in order to establish a clear characterization of the type species, thereby defining the genus Adelocoenia, and providing the basis for distinguishing it from closely corresponding taxa, especially Pseudocoenia.

2. The following characters have been identified: massive plocoid corallum. Radial elements are compact, free, bicuneiform costosepta, non-confluent, mostly attenuated (occasionally a small enlargement at the inner edge), straight, unequal in length and clearly organized according to an octameral plan with 8 major septa and 8 minor septa. Bilateral arrangement might occur as a result of elongation of both calices and calicular fossae. The ornamentation of septa is very weak and the initial relief of the ornamentation becomes smooth as a result of thickening deposits. Secondary trabecular axes irregularly emerge from the mid-septal plan toward the septal faces. No pali. Endotheca made of tabulae or tabuloid dissepiments, rarely vesicular. Peritheca made of vesicular dissepiments. Columella absent but a clear central subicular fossa present (in one out of 32 corallites, however, structures are present which may or may not correspond to a columella). Wall parathecal, developed in continuity with thickening deposits of septa.
Dimensions:
- Diameter of colony 11 cm; height of the colony: 12.5 cm.
- Diameter of calices: lumen: 2.2 to 3.2 mm; middle of the wall 3.2 to 4.1 mm; external diameter (from costa to costa): 4.1 to 5.4 mm.

3. The specimen designated here as neotype is MNHN.F.M00001 (MICHELIN coll.) of Stenay (Ardenne) (Oxfordian) and figured on Figure 3.

4. We decided to designate a neotype because, as already stated by ALLOITEAU (1949, p. 701), the original type series appears to be lost. After numerous attempts carried out over a long period of time by the authors of the current work in the MNHN collections to track down the original material, we as well came to the conclusion that the original type series has to be considered lost.

5. The specimen chosen as the neotype agrees very closely with the original description by MICHELIN (1844, p. 118). Despite his rather basic description compared to modern ones, we understand from the description that this coral has octameral septal arrangement with two size orders of septa. In addition, in the original figure it can be seen that MICHELIN’s material represents a colonial form that is characterized by 1) plocoid corallite integra-
- 3) a costulated peritheca, and 3) lacks a columnella.

6. In order to comply with the ICZN recommendation 75A, we have looked for a new sample from the same locality or neighbouring localities. In the original work of MICHELIN, the type localities are Bay-bel (Ardenne), Sampigny and Goussaincourt (Meuse). Bay-bel is a locality that does not exist anymore in the Ardennes department. There is a village named Bay in which strata occur that are Cretaceous in age. The development of the strata at the localities of Sampigny and Goussaincourt are associated with the middle Oxfordian reefal event. The specimen we selected from MICHELIN’s collection is labelled Stenay (Ardenne). Despite the fact that it is a place without any known reefal sediments, it is located in the type area in the vicinity of these previously mentioned middle Oxfordian reefs. We assume that the specimen was most likely derived from one of the small localities nearby Stenay. Further reason for selecting this specimen is its excellent state of preservation, especially when compared to contemporaneous reefal material, including the topotype of ORBIGNY’s collection mentioned under remarks above.

7. The neotype designated herein is housed at MNHN Paris under MNHN.F.M00001.

**Synonymy of Adelocoenia castellum (MICHELIN, 1844):**

v* 1844 Astrea castellum MICHELIN, p. 118, Pl. 27, fig. 4.
1849 Adelocoenia castellum (MICHELIN) - ORBIGNY, p. 7.
1850 Adelocoenia castellum (MICHELIN) - ORBIGNY, p. 32.
1850 Pseudocoenia suboctonis - ORBIGNY, p. 34.
1851b Styлина castellum (MICHELIN) - Milne EDWARDS & HAIME, p. 59.
1851b Styлина digitata (ORBIGNY) - Milne EDWARDS & HAIME, p. 61.
1851b Styлина ? suboctonis (ORBIGNY) - Milne EDWARDS & HAIME, p. 61.
1857 Styлина suboctonaria (ORBIGNY) - Milne EDWARDS, p. 248.
1861 Pseudocoenia ? suboctonis (suboctonaria) ORBIGNY - FROMENTEL, p. 192.
1864 Styлина Waldeckensis ÉTALLON, p. 372, Pl. 52, fig. 7.
1865 Styлина castellum (MICHELIN) - ÉTALLON, p. 366, Pl. 51, fig. 7.
1866 Styлина ? suboctonaria (ORBIGNY) - FROMENTEL, p. 22.
1865 Styлина castellum (MICHELIN) - FROMENTEL, p. 21.
1865-1869 Styлина solida (McCoy) - EICHWALD, p. 133.
1880 Cryptocoenia cotureses ACHIARO, p. 297, Pl. 20, fig. 3.
1881 Cryptocoenia octosepta ÉTALLON, p. 91, Pl. 29, fig. 1.
1881 Cryptocoenia octonaria ORBIGNY - KOBY, p. 92, Pl. 18, figs. 4-5.
1889 Cryptocoenia octosepta ÉTALLON, p. 122, figs. 1-3.
1889 Cryptocoenia waldeckensis (ÉTALLON) - KOBY, p. 466, Pl. 125, fig. 5.
1897 Styлина waldeckensis ÉTALLON - OGLIVIE, p. 172, Pl. 17, fig. 3.
1913 Cryptocoenia Böhm in SPEYER, p. 211, Pl. 21, fig. 10-10a.
1931 Pseudocoenia suboctonis ORBIGNY - COTTREAU, p. 158.
1937 Cryptocoenia octosepta (ÉTALLON) - MIRCHINK, p. 77.
1949 Pseudocoenia suboctonis ORBIGNY - ALLOITEAU, p. 704, Figs. 4-5.
1949 Adelocoenia heberti ALLOITEAU, p. 701, Fig. 1.
1949 Adelocoenia castellum (MICHELIN) - ALLOITEAU, p. 702, Fig. 2.
1955b Styлина waldeckensis ÉTALLON - GEYER, p. 184.
1957 Styлина waldeckensis ÉTALLON - FRAJOVÁ, p. 53.
1960 Cryptocoenia octosepta (ÉTALLON) - BENDUKIDZE, p. 17.
1960 Cryptocoenia octonaria ORBIGNY - BENDUKIDZE, p. 17.
1960 Cryptocoenia octonaria ORBIGNY - BENDUKIDZE, p. 17.
1963 Styлина castellum (MICHELIN) - BABAEV & GASANOVA, p. 4.
1963 Cryptocoenia castellum (MICHELIN) - BABAEV, p. 36.
Figure 3: Neotype herein designated of Adelocoenia castellum (MICHELIN, 1844), MNHN.F.M00001, type species of Adelocoenia; neotype designation herein. 3.1. General view of colony in transverse thin section. 3.2. Close-up of Figure 3.1, showing partly preserved microstructure with growth lines inside septa. 3.3. Close-up of Figure 3.1, showing general longitudinal view of colony, partially oblique. 3.4. Close-up of Figure 3.4, showing periodic arrangement of poorly developed auriculae. 3.5. Close-up of Figure 3.4, showing microstructural features in form midseptal black lines. 3.6. Close-up of Figure 3.4, showing general longitudinal view of colony, partially obl一起去空格子. 3.7. Close-up of Figure 3.4, showing microstructural features in form midseptal black lines. 3.8. Close-up of Figure 3.1, showing partly preserved microstructure with growth lines inside septa (center of the photo). 3.9. Remains of trabecular axes in the mid-septal plan. 3.10. Close-up of Figure 3.4, showing both tabulae and inclination of trabecular axes.

1963 Cryptocoenia octosepta (ÉTALLON) - BABAÉV, p. 36.
1964 Adelocoenia heberti ALLOITÉAU - BEAUVAIS, p. 119, Pl. 2, fig. 8.
1966 Pseudocoenia octonaria ORBIGNY - BEAUVAIS, p. 122, Pl. 5, figs. 4-5.
1967 Stylna castellum (MICHELIN) - Geyer, p. 231.
1967 Cryptocoenia castellum (MICHELIN) - BABAÉV, p. 140.
1967 Cryptocoenia octosepta (ÉTALLON) - BABAÉV, p. 140.
1973 Cryptocoenia octosepta (ÉTALLON) - BABAÉV, p. 77, Pl. 3, fig. 4.
1975 Adelocoenia schardi (KOBY) - BEAUVAIS, p. 32.
1982 Cryptocoenia cf. octosepta (ÉTALLON) - BENDUKIDZE, p. 11, Pl. 1, fig. 4.
1985 Cryptocoenia octosepta (ÉTALLON) - LIAO & XIA, p. 138, Pl. 5, figs. 4-5; Pl. 6, fig. 2.
1985 Pseudocoenia suboctonis ORBIGNY - ROSENDAHL, p. 35, Pl. 3, fig. 4.
1988 Pseudocoenia suboctonis (ORBIGNY) - FEZER, p. 87.
1990 Pseudocoenia suboctonis ORBIGNY - ERRENST, p. 171, Pl. 3, fig. 7a-b.
1991 Cryptocoenia castellum (MICHELIN) - LEBANIDZE, p. 8, Pl. 1, fig. 1.
1991 Cryptocoenia suboctonis ORBIGNY - LEBANIDZE, p. 9, Pl. 1, fig. 2.
1994 Cryptocoenia octosepta (ÉTALLON) - LIAO & XIA, p. 144, Pl. 36, fig. 3; Pl. 37, figs. 2-4.
1994 Pseudocoenia suboctonis ORBIGNY - ELIÁSOVÁ, p. 66.
2001 Pseudocoenia cf. suboctonis ORBIGNY - REUTER et al., p. 37.
2001 Pseudocoenia suboctonis ORBIGNY - LATERNSER, p. 162.
2002 Adelocoenia somaensis (MORI) - LÖSER & MORI, p. 82, Fig. 1.6.
2003 Pseudocoenia suboctonis ORBIGNY - HELM et al., p. 82.

Remarks: Stylna castellum (MICHELIN) in ÉTALLON, 1864, is excluded from the synonymy because it has 32 costae. In addition, it seems to have a columella. In having a very low number of septa (8-10), the material assigned to Cryptocoenia castellum (MICHELIN) in BENDUKIDZE (1960, 1982) is included here. Because, in addition to features seen in Adelocoenia, the material assigned to Cryptocoenia suboctonis (ORBIGNY) in LIJULÉVA & PERMYÁKOV (1980) also shows characteristics of Cyathophora, it is only tentatively grouped with the species castellum.

Synonymized nominal species:
- Pseudocoenia suboctonis ORBIGNY, 1850
  Type material: lectotype MNHN.F.A53898 designated by ALLOITÉAU, 1949 (ICZN art. 74.5). Type locality: Oxfordian-Kimmeridgian of Tonnerre (France).
  Remarks: S3 visible as costae only in adult stages; granules on lateral faces and enlarged inner edges forming auriculae clearly visible in longitudinal section. Endotheca with tabulae fairly constant, vesicular disepithecous present only in peritheca.
- Pseudocoenia digitata ORBIGNY, 1850
  Type material: syntypes MNHN.F.A09448 MNHN.F.A09449 MNHN.F.A09450 MNHN.F.A09451; thin section of the last specimen available.
  Type locality: Upper Jurassic from Tonnerre (Yonne, France).

Figure 4: Paleobiogeographical distribution of A. castellum (MICHELIN, 1844). For the following maps, the paleoposition of continents corresponds to Dogger. Note that, consequently, a detailed palaeogeography of every chron is not displayed. Paleogeographic map and currents adapted form HAQ & EYSINGA (1987).
Dimensions of the type specimens:
A09451: D = 1.1 -1.3mm; c-c = 1.4-2.2 mm septal formula = 8S1 + 8S2.
A09449: D = 1.9- 2.6 mm, c-c = 3.2-4.6 mm septal formula = S1 + 8S2 + C3 (preserved in a very few places).
A09448: an imprint (moldic porosity). D = 1.4 mm, c-c = 1.8-4.2 mm, septal formula developed in the pattern of Nc = 2Ns (number of costae twice the number of septa).
A09450 groups several specimens, 2 thin sections are available: D = 1.3-2 mm; c-c = 2.4-4 mm. Septal formula = 8S1 + 8S2.
Remarks: The species has never been described in detail and the dimensions of its skeletal elements were unknown until now. This species was synonymized with Astrea limbata GOLDFUSS, 1826, by COTTREAU (1931, p. 160/28), a decision that was subsequently accepted by RONIEWICZ (1966). While the colonial shape of digitata is similar to limbata, the development of both septal formula and dimensions of skeletal elements in digitata more closely correspond to A. castellum.
- **Styliina waldeckensis ÉTALLON, 1864**
  Type material: syntype Styliina waldeckensis (coll. THURMANN MJSN O106).
  Type locality: Kimmeridgian of Waldeck, Croix dessus? (Switzerland).
As already mentioned by ÉTALLON (1864), despite its dominant octameral character, the septal symmetry varies in A. waldeckensis as it is hexameral in young corallites which is clearly visible in the syntype. The original drawing by ÉTALLON suggests the presence of a columella which, however, could not be confirmed for the syntype that was investigated by the authors of the current work. The material from Štramberk described by ОСЕ́Р ОСЕ́Р (1897) differs from S. waldeckensis in having a columella.
- **Cryptocoenia colturensis ACHIARDI, 1880**
  Type material: holotype by monotypy. MSNUP no. I 2520.
  Type locality: lower Tithonian of Monte Cavallo, Italy.
- **Convexastrea scharldti KÖBY, 1889**
  Type material: among the three available syntypes, MGL. GeoReg 4020, 2B, 8/1, 4965, we designate here as the lectotype the material figured by KÖBY (1889, Pl. 122, fig. 1) which corresponds to the largest specimen.
  Type locality: Couches à Mytilus (Bathonian), Rochers des Rayes and Chateau d’Oex, Switzerland.
  Remarks: inner edges of septa are clearly ornamented.
- **Cryptocoenia boehmi PRATZ in SPEYER, 1913**
  Type material: holotype by monotypy, probably lost (SNSB-BSPG, Munich) (last attempt to track down the material by one of the authors [RBS] carried out in March of 2019).
  Type locality: Upper Jurassic, Kehlheim, Germany.
  Status: Because the number of costae is unknown, the species cannot be reliably compared to other species.
- **Adelocoenia heberti ALLOITEAU, 1949**
  Type material: type specimen (MNHN coll. HeBERT, not found. BEAUVAIS (1964, p. 119) described the microstructure, suggesting that a thin section was available.
  Type locality: Oxfordian-Kimmeridgian of Tonnerre (Yonne, France).
- **Styliina (Convexastrea) somaensis MORI, 1963**
  Type material: holotype IGPS 85531.b.
  Type locality: Oxfordian-Kimmeridgian of Minaminosawa, Soma city, Fukushima Prefecture, Japan.
Paleobiogeography of A. castellum (Fig. 4): Bathonian of Switzerland; Oxfordian of France, Switzerland, Azerbaijan, Georgia, Poland, Czech Republic, Germany; Kimmeridgian of Germany, Spain, Georgia, France, Switzerland, Portugal; Oxfordian or Kimmeridgian of Japan, Portugal; Kimmeridgian-Tithonian of Crimea; Tithonian of Crimea; Upper Jurassic of Azerbaijan, Crimea, Italy, Tibet; Barremian of Serbia.

**5. Further Jurassic species grouped with Adelocoenia**

Due to the very large number of nominal taxa, the revision in the present paper is restricted to species that have their type material originating from the Jurassic. A revision of the Cretaceous nominal taxa will be presented in a separate work.

**5.1. Hexameral species of Adelocoenia**

**Adelocoenia bacciformis (MICHELIN, 1846)**

(Fig. 5)

Type material: syntype MNHN.F.M00045 (coll. MICHELIN). L. BEAUVAIS (1967, p. 13) mentioned a lost holotype and designated a neotype. In fact, no holotype was ever designated but a syntype has now become available (illustrated on the MNHN website). Consequently, the neotype designated by BEAUVAIS is invalid.
  Type locality: Bathonian of Langrune (France).
  Dimensions of the type specimen (from BEAUVAIS, 1967, p. 13): D = 1-1.5mm, c-c = 1.5-2.2mm depth of corallite 0.2 mm Ns = 12, Septal formula = 6S1 + 6S2, Nc = 12.
  v* 1846 Astrea bacciformis MICHELIN, p. 225; Pl. 54, fig. 11.
Figure 5: Syntype of A. bacciformis (MICHELIN, 1846), MNHN.F.M00045, polished distal surface.

1850 Cryptocoenia bacciformis (MICHELIN) - ORBIGNY, p. 322.
1850 Prionastraæa limitata ORBIGNY t. 1 - ORBIGNY, p. 322 (according to BEAUVAIS, 1967).
1851a Convexastrea waltoni - MILNE EDWARDS & HAIME, p. 109, Pl. 23, figs. 5-6.
1851 Cryptocoenia bacciformis (MICHELIN) - ORBIGNY, p. 164, Fig. 302.
1851b Styliina ? bacciformis (MICHELIN) - MILNE EDWARDS & HAIME, p. 59.
1857 Convexastrea waltoni MILNE EDWARDS & HAIME - MILNE EDWARDS, p. 279.
1861 Convexastrea waltoni MILNE EDWARDS & HAIME - FROMENTEL, p. 195.
non 1879 Astrea bacciformis (MICHELIN) - QUENSTEOT, p. 623, Pl. 166, fig. 13 (has a columella).
1864 Styliina bernensis ÉTALLON - ÉTALLON, p. 366, Pl. 51, fig. 5.
1865 Convexastrea waltoni MILNE EDWARDS & HAIME - FROMENTEL, p. 22.
? 1884 Convexastrea waltoni MILNE EDWARDS & HAIME - TOMES, p. 706.
v 1889 Convexastrea gillieroni - KOBY, p. 470, Pl. 122, figs. 7-10.
v 1958 Elasmophora Collignonii - ALLOITÉAU, p. 32, Pl. 22, figs. 7-8.
1966a Adelocoea gillieroni (KOBY) - BEAUVAIS, p. 119.
v 1967 Adelocoea bacciformis (MICHELIN) - BEAUVAIS, p. 13, Fig. 2; Pl. 1, fig. 4; Pl. 4, fig. 6.
1970 Orbignycœnia waltoni (MILNE EDWARDS & HAIME) - BEAUVAIS, p. 47, Pl. C, fig. 1; Pl. D, fig. 4.

1971 Adelocoea bacciformis (MICHELIN) - BEAUVAIS, p. 2.
1971 Adelocoea gillieroni (KOBY) - BEAUVAIS, p. 2.
1971 Orbignycœnia waltoni (MILNE EDWARDS & HAIME) - BEAUVAIS, p. 2.
1975 Adelocoea gillieroni (KOBY) - BEAUVAIS, p. 32.
1983 Adelocoea bacciformis (MICHELIN) - BEAUVAIS, p. 47, Pl. 3, fig. 2.
1989 Adelocoea bacciformis (MICHELIN) - BEAUVAIS, p. 257.

Status: valid.

Synonymized nominal species:

- Convexastrea waltoni MILNE EDWARDS & HAIME, 1851a

Type material: lectotype designation by BEAUVAIS (1970, p. 47) by inference of specimen CAMSM no. J 5843 as holotype. In his list of types, Woods (1891, p. 1) mentioned two syntypes. Type locality: Great Oolite (Bathonian) of Hampton Cliff near Bath (Somerset, UK).

- Convexastrea gillieroni KOBY, 1889

Type material: syntypes MGL, Geolreg4011, 2B, 8/1, 4964.

Type locality: Couches à Mytilus (Bathonian), Rochers des Rayes and Chateau d'Oex, Switzerland.

- Elasmophora collignonii ALLOITÉAU, 1958

Type material: holotype by original designation; MNHN.F.M05061.

Type locality: Callovian of Amboromihanto, Madagascar.

Remarks: ALLOITÉAU (1958, p. 31) created the new genus Elasmophora (type species E. collignonii). In order to clarify whether ALLOITÉAU’s genus belonged to Adelocoea or Solenocoenia, the polished surface of the holotype was studied, revealing structures that support our proposed synonymy with Adelocoea. In contrast to the original description, the septal formula is 6S1 + 6S2, Nc = 12 (and not 24 as stated by ALLOITÉAU, 1958).

Paleobiogeography of A. bacciformis (Fig. 6): Bajocian? of England and France; Bathonian of England, France; Callovian of Madagascar, Switzerland, Tunisia; Dogger of Indonesia (Sumatra); Oxfordian of Switzerland.

Figure 6: Paleobiogeographical distribution of A. bacciformis (MICHELIN, 1846).
Figure 7: Lectotype of *A. bachmanni* (Koby, 1881), NMBE 5015320.

**Adelocoenia bachmanni** (Koby, 1881) (Fig. 7)

Type material: lectotype fixed by inference of a holotype (ICZN 74.6) in BEAUV (1966b, p. 992), coll. Koby, Museum Bern.

Type locality: Couches à *Mytilus*, Bathonian of Boltigen.

Dimensions of the type specimen, from BEAUV (1966b, p. 992): D = 2.3-3 mm, c-c = 2.8-5 mm Ns = 12, septal formula = 6S1 + 6S2, Nc = Ns.

v* 1881 Convexastraea bachmanni Koby, p. 103, Pl. 23, fig. 5.

v 1905a Convexastrea kiliani Koby - Koby, p. 854, Pl. 54, fig. 1.

1958 *Adelocoenia madagascariensis* ALLOITEAU, p. 19, Pl. 8, fig. 4; Pl. 22, fig. 16; Pl. 25, fig. 5.

1966b *Adelocoenia bachmanni* (Koby) - BEAUV, p. 992, Pl. 2, fig. 1.

1971 *Adelocoenia bachmanni* (Koby) - BEAUV, p. 2.

1975 *Adelocoenia bachmanni* (Koby) - BEAUV, p. 32.

1987 *Adelocoenia bachmanni* (Koby) - BEAUV IN VIT, TAB. B 15A.

Status: valid. However, assignment to *Solenocoenia* cannot be excluded. Only the study of a longitudinal section of the type material could clarify its taxonomic position.

Synonymized nominal species:

- **Convexastrea kiliani** Koby, 1905a
  
  Type material: holotype MNHN.F.A32027 (coll. Koby).
  
  Type locality: Bathonian of Roquefort Clamarchier (Alpes Maritimes, France) (figured on the MNHN website).

- **Adelocoenia madagascariensis** ALLOITEAU, 1958
  
  Type material: holotype MNHN.F.M05007 (coll. Bassé).
  
  Type locality: upper Bathonian-lower Callovian of Ankazomihéva, Madagascar (figured on the MNHN website).

Paleobiogeography of *A. bachmanni* (Fig. 8): Bathonian of France; Bathonian or Callovian of Switzerland (Couches à *Mytilus*); upper Bathonian-lower Callovian of Madagascar; Callovian of Tunisia; Oxfordian of Saudi Arabia.

**Adelocoenia compressa** (Koby, 1881), nov. comb. (Fig. 9)

Type material: lectotype by inference of a holotype in BEAUV (1966b, legend of Pl. 3; Pl. 31, fig. 1), NMBE 5015323 figured by Koby (1881, Pl. 31, fig. 2) is the lectotype, NMBE 5015322 is the paralectotype.

Type locality: Couches à *Mytilus*, Bathonian of Boltigen (Switzerland).

Dimensions of the lectotype specimen according to BEAUV (1966b, p. 993): D = 0.8-2 mm; up to 2.3 mm for the whole corallite according to our observation; c-c = 1-2.8 mm, Ns = 12 + s, septal formula = 6S1 + 6S2 + nS3 (often abortive), Nc = up to 24 according to our observation.

pars 1850 Prionastraea limitata ORBIGNY - ORBIGNY, p. 32.

v* 1881 Cryptocoenia compressa Koby, p. 87, Pl. 31, figs. 1-2.

1883 **Cryptocoenia microphylla** TOMES, p. 179, Pl. 7, fig. 2.

1884 **Cryptocoenia microphylla** TOMES - TOMES, p. 708.

1894 Convexastraea waltoni MILNE EDWARDS & HAIME - Koby, p. 9, Pl. 3, figs. 3-5.


? 1964 Cryptocoenia compressa Koby - KOLOSVARY, p. 221.

Figure 8: Paleobiogeographical distribution of *A. bachmanni* (Koby, 1881).
Figure 9: Lectotype of *A. compressa* (Koby, 1881), NMBE 5015323.

1966a Adelocœnia microphylla (TOMES) - BEAUVAIS, p. 119.
1966b Adelocœnia microphylla (TOMES) - BEAUVAIS, p. 992, Pl. 2, fig. 2.
1966b Adelocœnia microphylla var. compressa (Koby) - BEAUVAIS, p. 993, Pl. 3, fig. 1; Pl. 4, fig. 1.
1967 Adelocœnia microphylla (TOMES) - BEAUVAIS, p. 14, Pl. 1, fig. 6.
1971 Adelocœnia microphylla (TOMES) - BEAUVAIS, p. 3.
1975 Adelocœnia microphylla (TOMES) - NEGUS & BEAUVAIS, p. 188, Pl. 1, fig. 2.
1975 Adelocœnia microphylla var. compressa (Koby) - BEAUVAIS, p. 32.
1983 non Adelocœnia microphylla (TOMES) - KRASNOV, p. 83, Fig. 38.
1993 Adelocœnia microphylla (TOMES) - BEAUVAIS & NOUIOUAT, p. 310, Pl. 3, fig. 2; Pl. 4, fig. 1.

Remarks: *A. compressa* differs from both *A. bachmanni* and *A. bacciformis* by the number of costae, which is 12 in *A. bachmanni* and *A. bacciformis*.

Status: valid.

Synonymized nominal species:
- *Cryptocoenia microphylla* TOMES, 1883

Type material: lectotype NHMUK R8473 fixed by NEGUS and BEAUVAIS (1975, p. 188) (inference of a holotype). In her previous work, while syntypes were available, BEAUVAIS (1967, p. 14) erroneously mentioned a holotype but gave no specimen number, making it impossible to identify a lectotype by inference of a holotype according to the ICZN 74-6. Type locality: Bathonian of Fairford (Gloucestershire, UK).

Remarks: Assignment to Solenocoenia is not excluded, especially with regard to the material described in BEAUVAIS (1966b, p. 992, Pl. 2, fig. 2f). Because the material assigned to “*A. microphylla*” in KRASNOV (1983, Fig. 38) has a styliform columella, it is excluded from the synonymy of *A. microphylla*. KOLOSVÁRY (1964, p. 221) mentioned material he assigned to the species *compressa* from the Upper Jurassic of Romania, neither providing sufficient information nor giving any illustration. Therefore, the synonymy of this material is doubtful.

Paleobiogeography of *A. compressa* (Fig. 10): Bathonian of Switzerland, France, England, Saudi Arabia; Cretaceous of Tunisia; Middle Jurassic of Algeria; Upper Jurassic of the Czech Republic? and Romania?

**Adelocœnia luciensis** (ORBIGNY, 1850)

(Fig. 11)

Type material: lectotype MNHN.F.R54523 designated by BEAUVAIS (1967, p. 15), inference of a holotype ICZN (Art. 74-6). The material mentioned in BEAUVAIS (1966a, p. 12/124) is unrecognizable (no number and no photo).

Type locality: Bathonian of Luc sur mer, Normandy, France.

Dimensions of the type specimen: D = (1.5) 2-2.5 mm, c-c = 3.5-6.5 mm, Ns = 24-26, septal formula = 6S1 + 6S2 + 12S3 abortive + nS4, Nc = 24

v* 1850 Cryptocoenia luciensis - ORBIGNY, p. 322.
1851a Stylina ? luciensis (ORBIGNY) - MILNE EDWARDS & HAIME, p. 60.
1851b Cyathophora luciensis (ORBIGNY) - MILNE EDWARDS & HAIME, p. 107, Pl. 30, fig. 5.
1857 Cyathophora luciensis (ORBIGNY) - MILNE EDWARDS, p. 272.
? 1857 Cyathophora luciensis (ORBIGNY) - QMNUSTEDT, p. 554, Pl. 72, fig. 11.
1861 Cryptocoenia lucensis (ORBIGNY) - FROMENTEL, p. 199.
1865-1869 Cyathophora luciensis (ORBIGNY) - EICHWALD, p. 140, Pl. 9, fig. 9.
? 1879 Cyathophora luciensis (ORBIGNY) - QMNUSTEDT, p. 622, Pl. 166, fig. 12.
Figure 11: Lectotype of *A. luciensis* (ORBIGNY, 1850), MNHN FR 54523.

1881 *Cryptocoenia luciensis* ORBIGNY - TOMES, p. 156, 161.
1907 *Cryptocoenia luciensis* ORBIGNY - KOBY, p. 8.
v 1913 *Cryptocoenia luciensis* ORBIGNY - COTTREAU, p. 176, Pl. 32, figs. 9-11.
v 1958 *Cryptocoenia luciensis* ORBIGNY - ALLOITEAU, p. 30, Pl. 27, figs. 1, 9.
1964 *Adelocoenia luciensis* (ORBIGNY) - ALLOITEAU & FARAG, p. 59, Pl. 3, fig. 2.
1966a *Cryptocoenia luciensis* ORBIGNY - BEAUVAIS, p. 11 / 123.
v 1967 *Cryptocoenia luciensis* ORBIGNY - BEAUVAIS, p. 15.
1971 *Cryptocoenia luciensis* ORBIGNY - BEAUVAIS, p. 3.
1980 *Cyathophora luciensis* (ORBIGNY) - LIJULEVA & PERMYAKOV, p. 127, Pl. 49, fig. 6, 7; Pl. 50, figs. 1-2.

Remarks: Because the material described in QUENSTEDT (1857, p. 554; 1879, p. 622) seems to show an S2 development that differs from ORBIGNY’s species, it is grouped with *A. luciensis* only tentatively. In the lectotype of *A. luciensis*, especially in the proximal face of the colony, tabulae do exist and there is no two-zoned endotheca. S1 is occasionally slightly enlarged at the inner edge.

Status: valid.

Paleobiogeography of *A. luciensis* (Fig. 12): Bathonian of France, England, Germany, Madagascar; Callovian of Egypt, Crimea (Ukraine), Callovian? of Tunisia.

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**Adelocoenia tenuistriata** (KOBY, 1889), nov. comb. (Fig. 13)

Type material: syntypes MGL, Geolreg 4012, 2B, 8/1, 4965 (coll. SCHARDT and RITTENER). We designate here as the lectotype the specimen shown in fig. 14 on Pl. 122 of KOBY (1889), which is the best preserved specimen.

Type locality: Couches à *Mytilus*, Bathonian Rochers des Rayes / Château d’Oex (Switzerland).

Dimensions of the lectotype: D = 3-4 mm, c-c = 4-8 mm, septal formula = 6S1 + 6S2 + 12S3, Nc = 32-48.

v 1907 *Cryptocoenia delaunayi* KOBY, p. 7, Pl. 2, figs. 8-9.
1964 *Adelocoenia trisexradiata* ALLOITEAU & FARAG, p. 61, Pl. 4, fig. 2.
v 1972a *Pseudocoenia delaunayi* (KOBY) - BEAUVAIS, p. 46, Pl. A, fig. 8.
v 1972a *Pseudocoenia kobyi* BEAUVAIS, p. 47, Pl. A, fig. 9.
v 1975 *Cryptocoenia tenuistriata* KOBY - BEAUVAIS, p. 32.

Status: valid.

Synonymized nominal species:
- *Cryptocoenia delaunayi* KOBY, 1907

Type material: figured syntypes are available in Basel NMB under the inventory numbers D 6449 and 6450. In addition, a non-figured syntype is stored in Paris MNHN.F.B47514. A “neoholotype” proposed by BEAUVAIS (1972a, p. 14/46) cannot be accepted as a neotype because, among other reasons, syntypes are available. Because one of the syntypes seems to rather belong to the family Cyathophoridae, we designate herein the sample D6450 as the lectotype.

Type locality: Bathonian of Saint-Gaultier (Indre, France).
- *Adelocoenia trisexradiata* ALLOITEAU & FARAG, 1964

Type material: syntype. Geological Museum of Cairo (Egypt) under no. 25210-25268.

Type locality: Jeham (Risan Aneiza, Egypt).

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**Figure 12:** Paleobiogeographical distribution of *A. luciensis* (ORBIGNY, 1850).
Figure 13: Lectotype of A. tenuistriata (Koby, 1889), MGL Geolreg 4012, 2B, 8/1, 4965. Enlargement of a calice with reprocessed image.

- Pseudocoenia kobyi Beuvais, 1972a
  
  Type material: holotype by original designation MNHN.F.B47515.
  
  Type locality: Bathonian of Saint-Gaultier (Indre, France).

Paleobiogeography of A. tenuistriata (Fig. 14): Bathonian of France; Callovian of Switzerland; Oxfordian-Kimmeridgian of Egypt.

Adelocoenia fallax (Becker, 1875), nov. comb.

Type specimen: lost. A specimen considered as a syntype (= SMNS 60019) is figured on the website of the Museum in Stuttgart.

http://www.dbsmns.naturkundemuseum-bw.de/dev5/anzeigen.php?is=12&inv=60019&objekt=14382

However, it seems very unlikely that this sample is the figured syntype. According to the original description by Becker (1875, p. 142, Pl. 36, fig. 12a-b), the species fallax is characterized by a septal formula of 6S1 + 6S2, whereas the specimen SMNS 60019 shows septa that are octamerally arranged. We have searched collections of various museums and paleontological institutions for a specimen corresponding to the description of Becker in order to designate a neotype, but without success. The only samples available in the Stuttgart collection that, within a certain range, corresponds to the diagnosis by Becker (1875) are specimens identified by Geyer.

Type locality: Kimmeridgian or Tithonian of Nattheim (Germany).

Dimensions of the type specimen: D = 0.6-1 mm according to Becker; 1-1.5 mm according to Geyer, septal formula = 6S1 + 6S2, Nc = 24 costae.

Non-revised synonymy:

- 1866 Stylina limbata (Goldfuß) - Bölcke, p. 451.
- * 1875 Stylina fallax Becker, p. 142, Pl. 36, fig. 12.
- 1877 Stylina fallax Becker - Struckmann, p. 536.
- 1881 Cryptocoenia thiessingi Koby - Koby, p. 86, Pl. 29, fig. 2.
- 1881 Cryptocoenia compressa Koby - Koby, p. 87, Pl. 31, figs. 1-2.
- 1914 Stylina fallax Becker - Schöndorf, p. 135.
- 1966 Pseudocoenia fallax (Becker) - Roniewicz, p. 181, Pl. 9, fig. 4.
- v. 1991 Stylina fallax fallax Becker - Lauxmann, p. 120.

Status: doubtful (awaiting a redefinition on the basis of a neotype).

Adelocoenia parvistella Alloiteau, 1961

(Fig. 15)

Type material: holotype MNHN.F.R10866 (coll. Durand-Delga).

Type locality: Tithonian of La Querola (Spain).

Dimensions of the holotype: D = 1-1.75 mm, c-c = 1.25-2 mm, septal formula = 6S1 + 6S2, Nc = 12 and higher.

v* 1961 Adelocoenia parvistella Alloiteau, p. 289, Pl. 9, fig. 5; Pl. 10, fig. 9.
- 1972 Pseudocoenia slovenica Turnšek, p. 164, 227, Pls. 4-5.
- 1976 Pseudocoenia slovenica Turnšek - Roniewicz, p. 48, Pl. 5, fig. 5.
- 1981 Pseudocoenia slovenica Turnšek - Eliášová, p. 125, Pl. 8, figs. 3-4.
- 1982 Pseudocoenia slovenica Turnšek - Papoyan, p. 65.
- 1985 Pseudocoenia slovenica Turnšek - Rosendahl, p. 34, Pl. 3, fig. 2.
- 1990 Pseudocoenia slovenica Turnšek - Errenst, p. 168, Pl. 3, fig. 1.

Figure 14: Paleobiogeographical distribution of A. tenuistriata (Koby, 1889).
The species is characterized by \( D = 0.8 \) to 1.5 mm and a septal formula of 6S1 + 6S2.

Status: we consider the species as valid. However, the taxonomic clarification of either \( A. \) fallax or \( A. \) delemontana could impact this status.

Remarks: In \( Adelocoenia \) parvistella, auriculae are present which clearly distinguishes it from genera such as \( Cyathophora \) (including its junior synonym \( Cryptocoenia \)). This represents an important fact, since \( ALOITEAU \) (1958) also erected a species \( Cryptocoenia \) parvistella, using material from the Cretaceous of Madagascar (MNHN.F.M05039; and thin sections). Because the latter is here considered to belong to \( Cyathophora \), the species is not a junior homonym.

Synonymized nominal species:

- **Adelocoenia slovenica** (TURNŠEK, 1972)

  Type material: holotype by original designation SAUZ P304.

  Type locality: upper Oxfordian-lower Kimmeridgian of Col (Slovenia).

  Some of the specimens from the Jurassic of Iran assigned to this species by PANDÉY and FÜRSCH (2003, p. 27), are considered to be Solenocoenia (for instance material shown on Pl. 6, fig. 5). In addition, it should be noted that these authors place within \( A. \) slovenica material having dimensions that significantly differ from \( slovenica \) (e.g., specimen SNSB-BSPG 1999VIII 874: \( D: 1.5-2.3 \) mm; and specimen SNSB-BSPG 1999VIII 1085: \( D: 1.5-2.6 \) mm). The consequence of such a wide grouping would be a much wider stratigraphic range for this species.

Paleobiogeography of \( A. \) parvistella (Fig. 16):

- Oxfordian of Germany, France; upper Oxfordian of Romania; Oxfordian-Kimmeridgian of Slovenia; lower Kimmeridgian of Romania; Kimmeridgian-Tithonian of Spain, Tithonian of Portugal; Tithonian-Berriasian of the Czech Republic and Poland; Upper Jurassic of Armenia and Japan; Valanginian of Switzerland (Alpstein area; Vitznau marl) (first time record herein; material provided by Peter KÜRSTEINER and Karl TSCHANZ, Switzerland; Naturmuseum St. Gallen, Coll. Peter KÜRSTEINER, NMSG-02.10.23 and 02.10 27 to 02.10.32).

**Adelocoenia \? delemontana** (KOBY, 1889), nov. comb.

(Fig. 17)

Type material: syntype NMB D4924 (coll. KOBY), very poorly preserved.

Type locality: lower Kimmeridgian ("Ptérocérien") of Courroux Quarry, Vorbourg, near Delémont (Switzerland).

Dimensions of the syntype: \( D = 1 \) mm c-c = 2-3 mm, septal formula = 6S1 + 6S2.

\* 1889 Cryptocoenia delemontana KOBY, p. 468, Pl. 125, fig. 6 (not fig. 13 as mentioned by error).


Figure 16: Paleobiogeographical distribution of \( A. \) parvistella ALLOITEAU, 1961.
Figure 17: Syntype of A. ? delemontana (Koby, 1889), NMB D4924.

non 1982 Cryptocoenia aff. delemontana Koby - Bendukidze, p. 10.

Because the specimens described by Bendukidze (1960, p. 19; 1982, p. 10) from the Upper Jurassic of Georgia (in Caucasus) show octameral (material described in 1960) and decameral (material described in 1982) septal arrangements, they are excluded from the species delemontana. In A. delemontana, the septa are arranged hexamerially.

Status: The generic assignation is doubtful due to poor preservation.

Paleobiogeography of A. delemontana: Kimmeridgian of Switzerland, possibly earlier.

Adelocoenia pustulosa (Koby, 1905b), nov. comb. (Fig. 18)

Type specimen: two syntypes are available in Paris: MNHN.F.A32063 is designated herein as the lectotype (Fig. 18) and MNHN.F.A72655 is a paraleotype.

https://science.mnhn.fr/institution/mnhn/collection/f/item/a32063?listIndex=2&listCount=6

Type locality: Upper Jurassic "Couches d'Abbadia" of Casal-Novo, Cesareda and "Coralligne d'Amaral" of Adas Sovellas, Amaral, near Alhandra, Portugal.

Dimensions of the lectotype: D = 1 mm c-c = 2-3 mm Ns = 12, septal formula = 6S1 + 6S2, Nc = 24.

v* 1905b Cryptocoenia pustulosa Koby, p. 37, Pl. 7, figs. 8-10 (but not 5-7 as indicated by error on p. 37).
1955a Convexastrea pustulosa (Koby) - Geyer, p. 324.
1985 Convexastrea pustulosa (Koby) - Rosen Dahl, p. 36.
1995 Convexastrea pustulosa (Koby) - Nose, p. 109, Fig. 84.

Status: valid.

Remarks: A. pustulosa is distinguished from other Adelocoenia species by its: 1) rather small corallite diameter of 1 mm; 2) hexameral symmetry; 3) presence of non-confluent costae; and 4) the corallum shape, forming gibbose cylindrical branches.

Paleobiogeography of A. pustulosa: known only from the Kimmeridgian of Portugal.

Figure 18: Lectotype of A. pustulosa (Koby, 1905b), MNHN.F.A32063.
Adelocoenia radisensis (ORBIGNY, 1850)

(Fig. 19)

Type material: lectotype MNHN.F.R09326 designated by COTTREAU, 1931 (p. 158/26).

https://science.mnhn.fr/institution/mnhn/collection/item/r09326?listIndex=1&listCount=18

Type locality: Upper Jurassic of Loix (Île de Ré, Charente, France).

Dimensions of the lectotype: D = 2-3 mm, septal formula = 6S1 + 6S2, Nc = more than 12. Remeasured: D = 1.7 to 3.2 mm c-c = 2.7-5.1 mm.

v* 1850 Cryptocoenia radisensis ORBIGNY, p. 33.
1851b Styliina ? radisensis (ORBIGNY) - MILNE EDWARDS & HAIME, p. 61.
1857 Styliina radisensis (ORBIGNY) - MILNE EDWARDS, p. 239.
1861 Styliina ? radicensis (ORBIGNY) - FROMENTEL, p. 187.
1861 Convexastraea dendroidea FROMENTEL, p. 195.
1881 Convexastraea meriani KOBY, p. 102, Pl. 23, figs. 1-4.
1896 Cryptocoenia Lort-Phillipisi GREGORY, p. 291.
1897 Convexastraea sexradiata GOLDFUSS - OGLVIE, p. 179, Pl. 17, fig. 11.
1900 Styliina lort-philippsi GREGORY - GREGORY, p. 31.
1929 Styliina lort-philippsi GREGORY - LATHAM, p. 274.
1931 Cryptocoenia radisensis ORBIGNY - COTTREAU, p. 157, Pl. 6, fig. 5.
1932 Styliina aff. ablensis ÉTALLON n.f. ? - ZUFFARDI-COMERCI, p. 56, Pl. 1, fig. 1.

1935 Styliina lort-philippsi GREGORY - THOMAS, p. 28, Pl. 2, figs. 8-9.
1935 Styliina macfadyeni THOMAS, p. 28, Pl. 2, fig. 10 a, b, c.
p 1943 Styliina macfadyeni THOMAS - WELLS, p. 42, Pl. 6, fig. 3.
1943 Styliina sp. cf. S. lort-philippsi GREGORY - WELLS, p. 43.
1954 Convexastrea meriani suevica GEYER - GEYER, p. 135, Pl. 9, fig. 9.
1961 Adelocoenia meriani KOBY - BEAUVAIS, p. 2265.
1964 Adelocoenia dendroidea FROMENTEL - BEAUVAIS, p. 118.
1964 Cryptocoenia nivernensis BEAUVAIS, p. 125, Pl. 7, fig. 6.
1964 Adelocoenia meriani (KOBY) - BEAUVAIS, p. 120, Pl. 4, figs. 3-5.
1965 Convexastrea meriani KOBY - GEYER, p. 231.
p 1966 Pseudocoenia hexaphyllia (ORBIGNY) - RONIEWICZ, p. 182, Pl. 2, fig. 1.
1966 Pseudocoenia cf. radisensis (ORBIGNY) - RONIEWICZ, p. 182.
? 1968a Convexastraea dendroidea FROMENTEL - GEYER, p. 16, Pl. 1, fig. 5.
? 1968b Convexastraea dendroidea FROMENTEL - GEYER, p. 76.
1972b Cryptocoenia nivernensis BEAUVAIS - BEAUVAIS, p. 95.
1972 Pseudocoenia radisensis (ORBIGNY) - TURNŠEK, p. 163, 226, Pl. 3, figs. 3-4.
1974 Cryptocoenia nivernensis BEAUVAIS - BONNEAU et al., p. 75.
1976 Solenocoenia meriani (KOBY) - RONIEWICZ, p. 112.
1976 Pseudocoenia radisensis (ORBIGNY) - RONIEWICZ, p. 49, Pl. 4, fig. 4ab.
1981 Pseudocoenia beskidena ELJÁSÓVÁ, p. 125, Pl. 5, fig. 2; Pl. 6, fig. 12.
1982 Cryptocoenia radisensis ORBIGNY - BENDUKIDZE, p. 11, Pl. 2, fig. 1a-b.
1985 Convexastrea meriani KOBY - ROSENDAHL, p. 37, Pl. 1, fig. 2.
1985 Pseudocoenia radisensis (ORBIGNY) - ROSENDAHL, p. 34, Pl. 3, fig. 1.
1988 Pseudocoenia radisensis ORBIGNY - FEZER, p. 87.
? 1989 Pseudocoenia radiensis (ORBIGNY) - BEAUVAIS, p. 266, Pl. 64, fig. 2.
1990 Pseudocoenia beskidenia ELJÁSÓVÁ - ERRENST, p. 168, Pl. 3, fig. 2.

Figure 20: Paleobiogeographical distribution of A. radisensis (ORBIGNY, 1850).
1990 Pseudocoenia radiensis (ORBIGNY) - ERRENST, p. 169, Pl. 3, fig. 3a-b.
1991 Cryptocoenia radicisengis ORBIGNY - LEBANIDZE, p. 11, Pl. 2, fig. 2a-b.
1993 Cryptocoenia nivernensis BEAUVAIS - BEAUVAIS & NOUOUAT, p. 311, Pl. 4, fig. 3; Pl. 5, fig. 1.

Remarks: Study of the lectotype revealed the presence of auriculae. The occurrence of well-developed septa also suggests that the species belongs to Adelocoenia rather than Cyathophora. This species differs from A. bachmanni in having a higher number of costae.

Status: valid.

Synonymized nominal species:

- Convexastra? dendroidea? FROMENTEL, 1861
- Type material: holotype by original designation
- Type locality: Oxfordian-Kimmeridgian of France.
- Adelocoenia meriani KOBY, 1881
- Type material: lectotype designated by KOBY, 1884
- Type locality: Limestone maritime mountains of France.

Remarks: The species is assigned to Adelocoeonia on the basis of the figure given by THOMAS (1935), clearly indicating the absence of a columella.

- Styli? macfadyenci THOMAS, 1935
- Type material: holotype by original designation
- Type locality: Divesian-Argovian of Somaliland, Daghani section (Φ217 of THOMAS, 1935).

- Wells (1943) described two specimens, one with columella and another one without columella, explaining that the absence or occurrence of a columella is a matter of intracolonial variation. Based on our observations, we disagree with this statement.

- Cryptocoenia nivernensis BEAUVAIS, 1964

Type material: holotype by original designation MNHN.F.R10737 (coll. MOREAU).

Type locality: Oxfordian le Chalumeau, Alligny-Cosne (Nièvre, France).

Remarks: The number of costae is not twice the number of septa as stated by BEAUVAIS (1964, p. 125).

- Pseudocoenia beskidenia ELIAŠOVÁ, 1981

Type material: holotype by original designation, UUG no. HF 778, coll. UUG Prague.

Type locality: Tithonian of Stramberk, Czech Republic.

Paleobiogeography of A. radiciseng (Fig. 20): Oxfordian of Poland, Georgia, Switzerland, Greece; Oxfordian-Kimmeridgian of France, Romania; Oxfordian-Kimmeridgian of Slovenia, Sumatra; Portugal, Germany; Kimmeridgian of Spain, Germany, Crete, Colombia; Tithonian of Poland; Tithonian-Berrissian of the Czech Republic, "Divesian-Argovian" of Somaliland; Upper Jurassic of Somaliland; Jurassic of Ethiopia and Algeria; upper Berriasian of Switzerland; unknown age of Somaliland.

- Adelocoeonia hexaphyllia (ORBIGNY, 1850), nov. comb.

(Fig. 21)

Type specimen: lectotype MNHN.F.R09325.

Type locality: lower Kimmeridgian, La Rochelle (France).

Dimensions of the lectotype: D = 3.5-5 mm, sepal formula = 6S1 + 6S2 (+ S3), Nc = 24.

v+ 1850 Cryptocoenia hexaphyllia ORBIGNY, p. 33.
1851b Styli? hexaphyllia (ORBIGNY) - MILNE EDWARDS & HAZME, p. 60.
1852 Astrea cavernosa SCHLOTHEIM - SCHLOTHEIM, p. 417, Pl. 5, fig. 22.
1861 Styli? hexaphyllia (ORBIGNY) - FROMENTEL, p. 188.
1865 Styli? hexaphyllia (ORBIGNY) - FROMENTEL, p. 20.
1889 Convexastra hexaphyllia (ORBIGNY) - KOBY, p. 471, Pl. 125, fig. 1.
1909 Cryptocoenia cassettii PREVER, p. 996, Figs. 10-11.
1931 Cryptocoenia hexaphyllia ORBIGNY - COTTREAU, p. 155, Pl. 61, fig. 2.
1956 Cyathophora hexaphyllia (ORBIGNY) - LAFUSTE, p. 167.
1957 Cryptocoenia hexaphyllia (ORBIGNY) - LAFUSTE, p. 137.

v 1964 Cryptocoenia hexaphyllia ORBIGNY - BEAUVAIS, p. 126, Pl. 6, fig. 7.
Figure 21: Lectotype of *A. hexaphyllia* (ORBIGNY, 1850), MNHN.F.R09325.

1966 *Pseudocoenia hexaphyllia* (ORBIGNY) - RONIEWICZ, p. 182, Pl. 2, fig. 2.
1972 *Pseudocoenia hexaphyllia* (ORBIGNY) - TURŇŠEK, p. 162, 226, Pl. 3, figs. 1, 2, 5.
1976 *Pseudocoenia hexaphyllia* (ORBIGNY) - RONIEWICZ, p. 50, Pl. 4, fig. 3.
1978 *Pseudocoenia hexaphyllia* (ORBIGNY) - TURŇŠEK & MIHALOVIČ, p. 15-16, Pl. 10, figs. 3-4.
1981 *Pseudocoenia hexaphyllia* (ORBIGNY) - TURŇŠEK & MIHALOVIČ, p. 96, Pl. 1, figs. 1-2.
1982 *Pseudocoenia hexaphyllia* (ORBIGNY) - RONIEWICZ, p. 50, Pl. 4, fig. 3.
1985 *Pseudocoenia hexaphyllia* (ORBIGNY) - ROSENDAHL, p. 34, Pl. 4, fig. 5.
1985 *Pseudocoenia hexaphyllia* (ORBIGNY) - LIAO & XIA, p. 137, Pl. 4, fig. 4.
1989 *Pseudocoenia hexaphyllia* (ORBIGNY) - BEAUVAIS, p. 266.
1990 *Pseudocoenia hexaphyllia* (ORBIGNY) - ERRENST, p. 169, Pl. 3, fig. 4a-b.
1991 *Cryptocoenia hexaphyllia* (ORBIGNY) - LEBANIDZE, p. 10, Pl. 2, fig. 1.
1993 *Pseudocoenia hexaphyllia* (ORBIGNY) - LIAO & XIA, p. 207, Fig. 2.11-12.
1994 *Pseudocoenia hexaphyllia* (ORBIGNY) - LIAO & XIA, p. 138-139, Pl. 36, figs. 1-2, 6-7.
1997 *Pseudocoenia hexaphyllia* (ORBIGNY) - TURŇŠEK, p. 168.
2003 *Pseudocoenia hexaphyllia* (ORBIGNY) - PANDEY & FÜRSCHE, p. 26, Pl. 3, fig. 2, non fig. 4.

2012 *Pseudocoenia hexaphyllia* (ORBIGNY) - MORYCOWA, p. 9-10, Fig. 4-E.
2015 *Pseudocoenia cf. hexaphyllia* (ORBIGNY) - KOŁODZIEJ, p. 182.
2018 *Pseudocoenia hexaphyllia* (ORBIGNY) - BARON-SZABÓ, p. 77, Pl. 11, fig. C.

Remarks: S3 are substantially reduced, their costal counterparts are not always visible.

Status: valid.

Synonymized nominal species:

- *Cryptocoenia cassettii* PREVER, 1909
  
  Type material: syntype: MGPUT 19042 is a little rock sample (Fig. 10 of the plate in PREVER) and the two thin sections (Fig. 11, no fig.) are 19042.1 and 19042.2.
  
  Type locality: Upper Jurassic of Calascio (Italy).

Paleobiogeography of *A. hexaphyllia* (Fig. 22):

- Middle Jurassic - Kimmeridgian of Iran; Oxfordian of France, Poland, Georgia; Oxfordian-Kimmeridgian of Slovenia, Portugal, Tibet; Kimmeridgian of France, Germany, Romania, Spain; Kimmeridgian-Tithonian of Italy; Tithonian of Serbia, Poland; Upper Jurassic of Sumatra; upper Berriasian of Switzerland; Barremian of Serbia, redeposited in Stramberk type Barremian deposits of Poland.

*Adelocoenia choffati* (KOBY, 1905b), nov. comb.

Type material: syntype, probably housed in MG Lisboa.

Type locality: Kimeridgian of Outeiro Pragao, Barrio (Alcobaça), Portugal.

Dimensions of the original description: D = 5-6 mm (external diameter).

- 1905b *Cryptocoenia choffati* KOBY, p. 35, Pl. 9, figs. 9-10.
- 1905b *Cryptocoenia lusitanica* KOBY - BEAUVAIS, p. 126.
- 1955a *Stylina choffati* (KOBY) - GEYER, p. 341.
- 1964 *Cryptocoenia lusitanica* KOBY - BEAUVAIS, p. 126.

Status: valid.

Figure 22: Paleobiogeographical distribution of *A. hexaphyllia* (ORBIGNY, 1850).
Figure 23: Holotype of A. wegeneri (PANDEY & FÜRSICH, 1993), RUC 19921 248 with enlargement and topotype CPUN 002008 in longitudinal section.

Synonymized nominal species:

- **Cryptocoenia lusitanica** Koby, 1905b
  - Type material: syntypes MNHN.F.A32138.
  - Type locality: Kimmeridgian of Cesareda and Carrapateira (Algarve, Portugal).
  - Remarks: priority is given to *A. choffati* (Koby, 1905b), based on the decision by GEYER (1955a, p. 341), who was the first revisor.

Paleobiogeography of *A. choffati*: Oxfordian-Kimmeridgian of Portugal, France; Kimmeridgian of Crimea? (occurrence doubtful because material illustrated in LYLES & PERMYAKOV [1980] is not from Crimea but represents a reproduction of Koby's figures).

**Adelocoenia wegeneri** (PANDEY & FÜRSICH, 1993), nov. comb.

(Fig. 23)

- **1900** Stylina kachensis GREGORY - GREGORY, p. 58, Pl. 13, fig. 6 only.
- **1993** Cryptocoenia wegeneri PANDEY & FÜRSICH, p. 10, Fig. 8; Pl. 5, figs. 4, 6, 9.
- **2003** Cryptocoenia wegeneri PANDEY & FÜRSICH - PANDEY & FÜRSICH, p. 30, Pl. 3, fig. 7.

Type material: holotype by original designation. Housed at Jaipur. RUC1992 I 248. In addition to original figures used to make the determination, topotypes (CPUN 002007-002009) are available in Nancy for comparative analyses.

Type locality: Bathonian of Kachchh, Gujarat (India).

Dimensions of the holotype: D = 4.5-6 mm, c-c = 5-7 mm, Ns = 15-18, septal formula = 6S1 + nS2, Nc = 18-19.

Status: The number of both septa and costae is atypical for the genus *Adelocoenia* and justifies the validity of the species. It is atypical in the sense that the septa/costae sets are usually arranged in a multiple of 6, 8 or 10 within the genus. In *A. wegeneri* the first septal size order is clearly hexameral, made of long distinct septa. The interseptal space created by S1 is filled irregularly by one or two short septa of comparable size orders, resulting in a septal pattern that shows affinities to the genus *Bilaterocoenia* Moryowa, 1974. We thought that the species could find its place within the genus *Bilaterocoenia* Moryowa, 1974. However, the distribution of S2 is developed much too irregularly and can, therefore, not be considered as a characteristic reliably indicating a bilateral symmetry. The stability of this symmetry remains still to be demonstrated within the genus *Bilaterocoenia* itself.

The variability of features such as columella/columellar space is also a significant feature with regard to Bathonian species of *Adelocoenia*.

Paleobiogeography of *A. wegeneri*: Bathonian of Kachchh (India); Middle Jurassic of Iran (Tabas block, Northern Tethys margin).

5.2. Octameral species of *Adelocoenia*

**Adelocoenia lugdunensis** (ORBIGNY, 1850), nov. comb.

(Fig. 24)

Type material: lectotype MNHN.F.B09537 designated by THÉVENIN in COTTREAU (1907).

https://science.mnhn.fr/institution/mnhn/collection/f/item/b09537?listIndex=1&listCount=7

Type locality: Sinemurian of Saint-Fortunat, Saint-Didier-au-Mont-d’Or near Lyon (France).

Dimensions of the lectotype: D = 4 mm, septal formula = 8S1 + 8S2 + 16S3, Nc = 32.

- **1850** Octoœnia Lugdunensis ORBIGNY, p. 222.
- **1851a** Stylina lugdunensis (ORBIGNY) - MILNE EDWARDS & HAIME, p. 62.
- **1857** Stylina lugdunensis (ORBIGNY) - MILNE EDWARDS, p. 249.
- **1861** Stylina lugdunensis (ORBIGNY) - FROMENTEL, p. 192.
- **1907** Octoœnia lugdunensis (ORBIGNY) - THÉVENIN, p. 35, Pl. 10, figs. 23-24.

Status: valid.
Figure 24: Lectotype of A. lugdunensis (Orbigny, 1850), MNHN.F.B09537.

Remarks: Only one specimen is known.

Paleobiogeography of A. lugdunensis: Sinemurian of France.

Adelocoenia variseptata Beauvais, 1978

Type material: holotype NHMUK no. R5276.
Type locality: Bathonian of Kachchh, Gujarat (India).

Dimensions of the holotype: D = 2-3 mm c-c = 2.5-3.5mm, septal formula = 8S1 + 8S2 (adults but 6 or 7 S1 and 7-8 S2 in young corallites).

* 1978 Adelocoenia variseptata Beauvais, p. 48, Pl. 1, fig. 1.
1991 Adelocoenia variseptata Beauvais - Prinz, p. 176, Pl. 4, fig. 3.

Status: valid.

Paleobiogeography of A. variseptata: Bathonian of India; Aalenian of northern Chile.

Adelocoenia arcensis (Fromentel, 1861)

Type material: syntype, not found in the MNHN collections.

Type locality: Kimmeridgian (fide Fromentel) of Arc near Gray (Haute-Saône, France).

Dimensions of the original description: D = 1 mm, Ns = 16, Nc = 16.

* 1861 Cryptocoenia arcensis Fromentel, p. 199.

Status: valid.


Adelocoenia baltovensis (Roniewicz, 1966), nov. comb.

Type material: holotype ZPAL no. H III/190.
Type locality: upper Oxfordian of Baltów (Poland).

Dimensions of the type specimen: D = 3-3.5 mm, c-c = 5-7 mm, septal formula = 8S1 + 8S2, Nc = 32, endothecal density = 12-15/5 mm.

* 1966 Pseudocoenia baltovensis Roniewicz, p. 186, Pl. 4, fig. 3.
1985 Pseudocoenia baltovensis Roniewicz - Rosendahl, p. 35, Pl. 3, fig. 5.
2001 Pseudocoenia cf. baltovensis Roniewicz - Reuter et al., p. 37.
2003 Pseudocoenia cf. baltovensis Roniewicz - Helm et al., p. 83.

Status: Shows close affinities to A. pistillum (Fromentel, 1861), but is distinguished in having tabulae at a much higher density. These results are based on our observations made in a thin section of the lectotype of A. pistillum. The high density of tabulae in A. baltovensis justifies its taxonomic validity.

Remark. The species is well figured in Roniewicz (1966).

Paleobiogeography of A. baltovensis (Fig. 25): middle Oxfordian of Switzerland; upper Oxfordian of Poland, Germany; Oxfordian-Kimmeridgian of Slovenia, Portugal.

Adelocoenia breviseptata (Roniewicz, 1976), nov. comb.

Type material: holotype by original designation LPB Z13.

Type locality: lower Kimmeridgian of Topalu (Romania).

Dimensions of the holotype: D = 1.1-1.5 mm, c-c = 2.5-3.5 mm, Ns = 14-16, septal formula = 8S1 + 8S2, but also hexameral and heptameral.

* 1976 Pseudocoenia breviseptata Roniewicz, p. 50, Pl. 5, figs. 1-3.
1983 Pseudocoenia breviseptata Roniewicz - Beauvais, p. 43, Pl. 2, fig. 4.

Figure 25: Paleobiogeographical distribution of A. baltovensis (Roniewicz, 1966).
Astrea limbata (Goldfuss, 1826), nov. comb.

Type material: holotype IPB, no. 82 coll. Goldfuss Madrepora limbata. Another specimen housed in Bonn labeled as Astrea limbata Goldfuss is a sample belonging to the Goldfuss collection, but lacks an inventory number. This specimen was published in Goldfuss (1829) and does not correspond to the original figure in Goldfuss (1826, Pl. 8, fig. 7). It is in slightly better preservation and was assigned to the species Astrea limbata (originally described as Madrepora limbata) by Goldfuss himself.

Type locality: Upper Jurassic of Heidenheim (Germany).

Remarks: Goldfuss (1826, p. 22) created the new taxon Madrepora limbata. Later in 1829 (p. 110), he revised this species based on additional material, transferring it to the genus Astrea, but, at the same time, erroneously referring to it as a new species ("Astrea limbata nobis"). That created confusion in that subsequent works, authors have distinguished or mixed these two names in synonymies in such a confusing or complicated way that it is often difficult to understand to which Goldfuss reference they were referring. Here, despite the very problematic preservation of the original material (= holotype) described in 1826 (our Fig. 26), we assume that both samples belong to the same species. For a complete description of the species and a reliable identification of the species we refer to Koby (1881, p. 94) and Roniewicz (1966, p. 183).

Dimensions of the holotype: D = 1.5-2 mm, c-c = 3-5 mm, Ns = 16, septal formula = 8S1 + 8S2, Nc = 32.

2003 Pseudocoenia aff. breviseptata Roniewicz - Pandey & Fürsich, p. 26, Pl. 4, fig. 5.

Status: valid.

Remark. The species is well figured in Roniewicz (1976).

Paleobiogeography of A. breviseptata: Bajocian-Bathonian of Iran (but identification affinis); Kimmeridgian of Romania; Upper Jurassic of Philippines.

Astrea limbata (Goldfuss, 1826), nov. comb.

v* 1826 Madrepora limbata Goldfuss, p. 22, Pl. 8, fig. 7.

v 1829 Astrea limbata (Goldfuss) - Goldfuss, p. 110, Pl. 38, fig. 7.

1830 Tubastrea limbata (Goldfuss) - Blainville, p. 334.

1836 Astrea limbata Goldfuss - Lamarck, p. 410.

1844 Madrepora sublevis Michelin, p. 111, Pl. 25, fig. 5.

v 1844 Astrea limbata Goldfuss - Michelin, p. 108, Pl. 24, fig. 10.

1846 Madrepora limbata Goldfuss - Leymerie, p. 252.

1848 Oculina limbata (Goldfuss) - Bronn, p. 835.

v 1850 Pseudocoenia ramosa Orbigny - Orbigny, p. 34.

v p 1850 Pseudocoenia digitata Orbigny - Orbigny, p. 34.

1850 Lobocoea sublaevis (Michelin) - Orbigny, p. 40.

1850 Cryptocoenia limbata (Goldfuss) - Orbigny, p. 385.

1850 Pseudocoenia octonis Orbigny, p. 34.

1851b Stylista ? octonis (Orbigny) - Milne Edwards & Haime, p. 61.

1851b Stylista sublaevis (Michelin) - Milne Edwards & Haime, p. 60.

1851b Stylista limbata (Goldfuss) - Milne Edwards & Haime, p. 59.

1852 Astrea limbata Goldfuss - Quenstedt, p. 647, Pl. 57, fig. 18.


1859 Stylista octonia (Orbigny) - Étallon, p. 67/467.

1861 Stylista ? sublevis (Michelin) - Fromentel, p. 193.

1861 Stylista limbata (Goldfuss) - Fromentel, p. 188.

1861 Stylista octonia (Orbigny) - Fromentel, p. 190.

1861 Stylista ramosa Fromentel - Fromentel, p. 190.

1864 Stylista ramosa Fromentel - Étallon, p. 369, Pl. 32, fig. 1.

v 1864 Stylista virgulina Étallon, p. 372, Pl. 52, fig. 6.

1865 Stylista ? sublevis (Michelin) - Fromentel, p. 21.

1865 Stylista octonia (Orbigny) - Fromentel, p. 20.

1865 Stylista limbata (Goldfuss) - Fromentel, p. 20.

p 1866 Stylista limbata (Goldfuss) - Bölcske, p. 451.

1867 Astrea limbata (Goldfuss) - Quenstedt, p. 777, Pl. 74, fig. 18.

1875 Stylista limbata (Goldfuss) - Becker, p. 144.

1880 Astrea limbata (Goldfuss) - Quenstedt, p. 754, Pl. 172, figs. 33-41.

1881 Cryptocoenia limbata (Goldfuss) - Koby, p. 94, Pl. 21, figs. 1-5; Pl. 22, figs. 1-2.

1888 Cryptocoenia limbata (Goldfuss) - Solomko, p. 154.

1889 Cryptocoenia limbata (Goldfuss) - Koby, Pl. 129, fig. 5.

1904 Cryptocoenia limbata (Goldfuss) - Papp, p. 81.

1904 Cryptocoenia octonia (Orbigny) - Papp, p. 81.

1905b Cryptocoenia crateriformis Koby, p. 38, Pl. 8, fig. 1.

1905b Cryptocoenia delgadoi Koby, p. 39, Pl. 8, fig. 2.

1905b Cryptocoenia ramea Koby, p. 40, Pl. 8, figs. 4-7.

1908 Cryptocoenia octonia (Orbigny) - Zlatarski, p. 220.

p 1926 Stylista limbata (Goldfuss) - Speyer, p. 241.


1932 Stylista limbata (Goldfuss) - Frentzen & Karlshohn, p. 47.

1937 Cryptocoenia cartieri Koby - Mitchen, p. 77.

1954 Stylista limbata (Goldfuss) - Geyer, p. 132.

1955a Stylista limbata (Goldfuss) - Geyer, p. 323.

1960 Cryptocoenia limbata (Goldfuss) - Bendukidze, p. 20, Pl. 2, fig. 6.

non 1964 Cryptocoenia limbata (Goldfuss) - Kolosváry, p. 221, Pl. 3, fig. 19.

1963 Cryptocoenia limbata (Goldfuss) - Babaev, p. 37.

1963 Stylista limbata (Goldfuss) - Babaev & Gasanov, p. 4.

1963 Cryptocoenia octonia (Orbigny) - Babaev, p. 37.

1964 Pseudocoenia sublaevis (Michelin) - Beauvais, p. 122.

non 1964 Stylista limbata (Goldfuss) - Beauvais, p. 133, Pl. 6, fig. 5; Pl. 8, fig. 3.

1964 Pseudocoenia octonia (Orbigny) - Beauvais, p. 122, Pl. 5, figs. 4-5.

v 1964 Cryptocoenia michelini Beauvais, p. 126.

Figure 26: Holotype of A. limbata (OLDFUSS, 1826), IPB 82. For scale see the graph paper in the background of the first image. Other images are close-ups of the same sample.

1966 Pseudocoenia limbata (OLDFUSS) - RONIEWICZ, p. 183, Pl. 3, fig. 1a-d.
1967 Cryptocoenia octonaria (ORBIGNY) - BABAEV, p. 140.
1973 Stylista limbata (OLDFUSS) - BEAUVAIS, p. 324.
1973 Cryptocoenia limbata (OLDFUSS) - BABAEV, p. 79, Pl. 4, fig. 1.
1974 Stylista limbata (OLDFUSS) - KLOPFER, p. 74.
1975 Cryptocoenia limbata (OLDFUSS) - BENDUKIDZE & CHIKOVANI, p. 28-34.
1976 Pseudocoenia limbata (OLDFUSS) - RONIEWICZ, p. 51, Pl. 6, figs. 1a-c, 2.
1980 Cryptocoenia limbata (OLDFUSS) - LJULEVA & PERMYAKOV, p. 133, Pl. 59, figs. 4-5.
1980 Cryptocoenia crateriformis KOBY - LJULEVA & PERMYAKOV, p. 132, Pl. 61, figs. 1-2.
1981 Cryptocoenia stelliserrata BEAUVAIS & BERNIER, p. 180, Pl. 1, fig. 4; Pl. 2, fig. 4.
non 1982 Cryptocoenia limbata (OLDFUSS) - BENDUKIDZE, p. 12, Pl. 2, figs. 2-3a, b; Pl. 6, fig. 6.
non 1983 Stylista limbata (OLDFUSS) - BEAUVAIS, p. 42, Pl. 2, fig. 3.
1983 Pseudocoenia limbata (OLDFUSS) - KRAUSOV, p. 79, Fig. 35.
1985 Pseudocoenia limbata (OLDFUSS) - ROSENDAHL, p. 35.
1987 Cryptocoenia cf. limbata (OLDFUSS) - KHUSANOVA, p. 55, Pl. 2, fig. 3; Pl. 2a, fig. 2.
1988 Stylista limbata (OLDFUSS) - REIFF, p. 359.
1990 Pseudocoenia limbata (OLDFUSS) - ERRENST, p. 170, Pl. 3, fig. 6.
1993 Pseudocoenia limbata (OLDFUSS) - DOZET & TURNŠEK, p. 69, Pl. 1, fig. 3.
v 1997 Pseudocoenia limbata (OLDFUSS) - TURNŠEK, p. 169 cum fig.
2000 Cryptocoenia michelini BEAUVAIS - MEYER, p. 44.
2001 Pseudocoenia limbata (OLDFUSS) - REUTER et al., p. 37.
2003 Pseudocoenia limbata (OLDFUSS) - HELM et al., p. 82, Fig. 7B.
p 2003 Pseudocoenia limbata (OLDFUSS) - PANDY & FÜRISCH, p. 25, Fig. 4A ?, non 4B.
2005 Pseudocoenia cf. limbata (OLDFUSS) - HELM, p. 100, Pl. 32, figs. 1-2.
v 2012 Pseudocoenia limbata (OLDFUSS) - ZAMAN, p. 150, Pls. 30-31, tab. 31-33.
2015 Pseudocoenia cf. limbata (OLDFUSS) - KOŁODZIEJ, p. 182.
v 2018 "Pseudocoenia" limbata (OLDFUSS) - RICCI et al., p. 462, Pl. 13, figs. 1abc, 3.

Status: valid
Synonymized nominal species:
• Madrepora sublevis MICHELIN, 1844
  Type material: neotype MNHN MICHELIN coll. no. 567, designated by BEAUVAIS (1964, p. 123), not found.
  Type locality: Kimmeridgian of Landeyron (France).

Figure 27: Paleobiogeographical distribution of A. limbata (OLDFUSS, 1826).
Figure 28: Lectotype of *A. splendens* (FROMENTEL, 1861), MNHN.F.M03933.

- **Pseudocoenia octonis ORBIGNY, 1850**
  Type material: syntypes lost according to COTREAU (1931, p. 160/28). BEAUVAS (1964, p. 122) mentioned a holotype without a precise designation among the syntypes except she designated the type locality: La Rochelle. "Corallien" of La Rochelle. Other initial type localities were Vauligny near Tonnerre, Loix (Ile de Ré), Oyonnax, Châtel-Censoir (all in France).

- **Styliina virgulina ÉTALLON, 1864**
  Type material: syntype MJSN S1192 (coll. THURMANN).
  Type locality: Kimmeridgian of Waldeck (Switzerland).
  Status: probably a junior synonym of *A. limbata*. The peritheca of the type specimen is too poorly preserved to verify the synonymy.

- **Cryptocoenia ramea KOBY, 1905b**
  Type material: syntype not found.
  Type locality: Upper Jurassic of Abbadia Valley (Couches d’Abbadia), Amaral, Panasqueira ("Coralligène d’Amaral"), Cesareda, Portugal.
  Status: according to GEYER (1955a) and ROSENDAHL (1985), this species is a junior synonym of *A. limbata*. We follow their decision.

- **Cryptocoenia crateriformis KOBY, 1905b**
  Type material: holotype by monotypy. Probably housed in MG Lisboa.
  Type locality: Oxfordian/Kimmeridgian of Moulin de Tojeira (Portugal).
  Remarks: KOBY (1905b, p. 40) distinguished "*Cryptocoenia* limbata" by the shape of colony and the distance between calices. According to GEYER (1955a) and ROSENDAHL (1985), this species is a junior synonym of *A. limbata*. We follow their decision.

- **Cryptocoenia delgadoi KOBY, 1905b**
  Type material: holotype by monotypy. Probably housed in MG Lisboa.
  Type locality: Moulin de Tojeira top of the "Couches de Montejunto", Bimammatum zone.
  Status: Following GEYER (1955a, p. 323) and ROSENDAHL (1985, p. 35), we consider this species as a junior synonym of *A. limbata*.

- **Cryptocoenia michelini BEAUVAS, 1964**
  Type material: holotype by original designation using *Astrea limbata* GOLDFUSS sensu MICHELIN.
  Type locality: Oxfordian of Saint-Mihiel (France).
  Status: junior synonym of *A. limbata*.

- **Cryptocoenia stelliserrata BEAUVAS & BERNIER, 1981**
  Type material: holotype by original designation of *Cryptocoenia stelliserrata* BEAUVAS & BERNIER, specimen FSL 133533.

Figure 29: Paleobiogeographical distribution of *A. splendens* (FROMENTEL, 1861).
Type locality: upper Kimmeridgian (Calcaires de Valfin) of Valfin-lès-St-Claude (Jura, France).

Paleobiogeography of *A. limbata* (Fig. 27): ? Callovian-Oxfordian of Iran (Tabas block) (illustration inconclusive); Oxfordian of France, Switzerland, Germany, Poland, Crimea, Uzbekistan, Bulgaria, Portugal; Oxfordian-Kimmeridgian of Azerbaijan, Slovenia; Kimmeridgian of Germany, Switzerland, Portugal, Azerbaijan, France, Romania, Spain; Kimmeridgian-Tithonian of Romania, Italy; Tithonian of North Ossetia, Georgia, Azerbaijan, Crimea, Poland?; Upper Jurassic of Crimea, Georgia, Azerbaijan.

**Adelocoenia splendens**
* (FROMENTEL, 1861), nov. comb.
*(Fig. 28)*

Type material: lectotype MNHN.F.M03933 designated by ALLOITEAU (1956).
https://science.mnhn.fr/institution/mnhn/collection//item/m03933

Type locality: Oxfordian of Charcenne (Haute-Saône, France).

Dimensions of the lectotype specimen: D = 5-6 mm, septal formula = 8S1 + 8S2, Nc = 32.

v* 1861 Styliina splendens FROMENTEL, p. 189.
1865 Styliina splendens FROMENTEL - FROMENTEL, p. 21.
1964 Cryptocoenia splendens (FROMENTEL) - BEAUVAIS, p. 130, Pl. 7, fig. 1.
1964 Cryptocoenia fromenteli BEAUVAIS - BEAUVAIS, p. 130, Pl. 5, fig. 6.
1966 Pseudocoenia fromenteli (BEAUVAIS) - RONIEWICZ, p. 186, Pl. 2, fig. 3.
1977 Pseudocoenia fromenteli (BEAUVAIS) - PAPOYAN, p. 33, Pl. 3, figs. 2-3.
1982 Pseudocoenia fromenteli (BEAUVAIS) - LIAO, p. 158, Pl. 6, fig. 1.
1985 Pseudocoenia fromenteli (BEAUVAIS) - ROSENDHAL, p. 35, Pl. 3, fig. 3.
1990 Pseudocoenia fromenteli (BEAUVAIS) - ERRENST, p. 172, Pl. 4, fig. 2ac.
1990 Pseudocoenia splendens (FROMENTEL) - ERRENST, p. 172, Pl. 4, fig. 3a-c.
1994 Pseudocoenia fromenteli (BEAUVAIS) - LIAO & XIA, p. 138, Pl. 34, fig. 1.
2001 Pseudocoenia splendens (FROMENTEL) - LATERNER, p. 162.
2001 Pseudocoenia fromenteli (BEAUVAIS) - REUTER et al., p. 37, Fig. 7.5.
2003 Pseudocoenia fromenteli (BEAUVAIS) - HELM et al., p. 83, Fig. 7C.

Status: valid.

Synonymized nominal species:
- Adelocoenia fromenteli (BEAUVAIS, 1964)

Type material: holotype Styliina castellum MICHELIN in FROMENTEL, not found in the MNHN collections.

Type locality: Oxfordian of Charcenne (Haute-Saône, France).

Remarks: According to BEAUVAIS, the species fromenteli possesses a tabularium. In contrast, based on the study of material from Poland, RONIEWICZ (1966, p. 186) described and illustrated both complete and incomplete tabulae.

Paleobiogeography of *A. splendens* (Fig. 29): Oxfordian of France, Germany, Switzerland, Poland, Portugal; Oxfordian-Kimmeridgian of Armenia; Kimmeridgian of Spain; Upper Jurassic of Tibet.

**Adelocoenia tabulata**
* (ERRENST, 1990), nov. comb.
*(Figs. 30 - 31)*

Type material: Holotype by original designation, Mk 14, Bochum (housed in the near future in CPUN).

Type locality: Kimmeridgian, mountain slope, about 1 km southwest of Moscardon (Montes Universales, province Teruel (Spain).

Dimensions of the type specimen: D = 1-1.6 mm, c-c = 2-3.5 mm, septal formula = (7+7) 8S1 + 8S2, Nc = ca 16, De = 13/5 mm.
1990 Pseudocoenia tabulata ERRENST, p. 170, Pl. 3, fig. 5a-c.

Status: valid.


Paleobiogeography of *A. tabulata*: Kimmeridgian of Spain.

**Adelocoenia pistillum**
* (FROMENTEL, 1861), nov. comb.
*(Figs. 30 - 31)*

Type material: lectotype MNHN.F.R10818 (coll. FROMENTEL) by inference of a holotype in BEAUVAIS (1964, p. 128).

Type locality: Oxfordian of Charcenne (Haute-Saône, France).

Dimensions of the lectotype: D = 2-3.5 mm, c-c = 4-5.5 mm, Ns = 32, septal formula = 8S1 + 8S2, Nc = 32, endothecal density = 2-3/2.5 mm.

v* 1861 Styliina pistillum FROMENTEL, p. 190.
v non 1861 Styliina excentrica FROMENTEL - FROMENTEL, p. 190.
v 1861 Cryptocoenia brevis FROMENTEL, p. 199.
1864 Styliina castellum (MICHELIN) - ÉTALLON, p. 366, Pl. 51, fig. 7.
v 1864 Styliina decipiens ÉTALLON, p. 367, Pl. 51, fig. 9.
v non 1864 Styliina octosepta ÉTALLON - ÉTALLON, p. 369, Pl. 51, fig. 12.
v 1865 Cryptocoenia brevis FROMENTEL - FROMENTEL, p. 22.
v 1865 Styliina pistillum FROMENTEL - FROMENTEL, p. 21.
v 1880 Cryptocoenia subbrevis ACHIARDO, p. 296, Pl. 20, fig. 2.
v 1881 Cryptocoenia decipiens (ÉTALLON) - KOBY, p. 90, Pl. 20, figs. 1, 2-3.
v p 1881 Cryptocoenia cartieri (KOBY) - KOBY, p. 89, Pl. 22, figs. 3, 6, non 4, non 5.
? 1888 Styliina octosepta (?) ÉTALLON - SOLOMKO, p. 149.
1889 Cryptocoenia bonanomii KOBY, p. 467, Pl. 125, fig. 7.
v 1889 Cryptocoenia decipiens (ÉTALLON) - KOBY, p. 129, fig. 6.
1905b Cryptocoenia decipiens (ÉTALLON) - KOBY, p. 38, Pl. 8, fig. 3.
1913 Cryptocoenia aff. decipiens (ÉTALLON) - SPEYER, p. 212, Pl. 21, fig. 11-11a.
1954 Stylina decipiens ÉTALLON - GEYER, p. 133.
1961 Cryptocoenia decipiens (ÉTALLON) - BENDUKIDZE, p. 25.
1963 Cryptocoenia decipiens (ÉTALLON) - BABAEV, p. 36.
v 1964 Cryptocoenia globula BEAUVAIS, p. 129, Pl. 3, fig. 6.
v 1964 Cryptocoenia alligniensis BEAUVAIS, p. 128, Pl. 10, fig. 1.
1965 Styлина decipiens ÉTALLON - GYER, p. 231.
1967 Cryptocoenia decipiens ÉTALLON - BABAEV, p. 140.
1976 Pseudocoenia decipiens (ÉTALLON) - RONIEWICZ, p. 52, Pl. 6, fig. 3.
1979 Cryptocoenia pistillum (FROMENTEL) - NEGUS & BEAUVAIS, p. 225.
1982 Cryptocoenia decipiens (ÉTALLON) - BENDUKIDZE, p. 9, Pl. 2, fig. 1a-b.
1985 Pseudocoenia decipiens (ÉTALLON) - LIAO & XIA, p. 137, Pl. 5, fig. 3.
1988 Styлина decipiens ÉTALLON - FEZER, p. 87.
1990 Pseudocoenia decipiens (ÉTALLON) - ERRENST, p. 171, Pl. 4, fig. 1a-c.

1994 Pseudocoenia decipiens (ÉTALLON) - LIAO & XIA, p. 137, Pl. 32, fig. 8.
v 2018 "Pseudocoenia" decipiens (ÉTALLON) - RICCI et al., p. 464, Pl. 13, fig. 2ab.

Status: valid.
Synonymized nominal species:

- **Styлина decipiens ÉTALLON, 1864**
  Type material: syntype MJSN no. O 206, S 2199, S2219 (coll. THURMANN & ÉTALLON), Porrentruy.
  Type locality: Oxfordian of Caquerelle, Pont d'Able (Switzerland).
- **Cryptocoenia brevis FROMENTEL, 1861**
  Type material: syntype MNHN.F.A32886.
  Type locality: Oxfordian of Charcenne (Haute-Saône, France).
- **Cryptocoenia subbrevis ACHIARDI, 1880** (see Fig. 31)
  Type material: holotype by monotypy, Museo geologico Universita di Pisa MSNUP (no. I 2519).
  Type locality: Tithonian of Coltura di Sotto (commune di Polcenigo) nel Monte Cavallo (northeastern Italy).
- **Cryptocoenia bonanomii KOBY, 1889**
  Type material: syntype, repository unknown, could possibly be in the collections of Porrentruy, Basel, Paris, Lausanne, or Geneva.
  Type locality: Kimmeridgian ("Ptérocèrien") of Vorbourg near Delémont, Courroux quarry.

Remarks: KOBY proposed to separate A. bonanomii from A. decipiens on the basis of the colonial morphology, more salient calices, and slightly smaller corallites. Based on the current knowledge regarding variability in plocoid scleractinian corals, we apply a different taxonomic model. In addition, it should be noted that because this species has not been used as a valid taxon after 1899, it represents a nomen oblitum.
• Cryptocoenia alligniensis Beauvais, 1964

  Type material: holotype by original designation MNHN.F.R10738.
  Type locality: Upper Jurassic ("Séquanien") of Alligny (Nièvre, France).

• "Cryptocoenia" globula Beauvais, 1964

  Type material: holotype by original designation, MNHN.F.R10816. In addition, three paratypes exist under the number A24812.
  Type locality: Oxfordian of Champlitte (Haute-Saône, France).

  Remarks: Because the holotype is poorly preserved due to silicification, some doubt remains regarding the generic identification as it could also belong to genera such as Cyathophora or Adelocoenia. However, structures seen in a para-type (presence of auriculae; septa show a significant inward development) support our hypothesis that this species belongs to Adelocoenia.

  Paleobiogeography of A. pistillum (Fig. 32): Oxfordian of France, England, Switzerland, Azerbaijan, Crimea, Georgia; Oxfordian-Kimmeridgian of Slovenia; Kimmeridgian of Switzerland, Germany, Portugal, Spain, Romania; Kimmeridgian-Tithonian of Italy; Upper Jurassic of Italy, Tibet.

5.3. Nonameral species of Adelocoenia

  Adelocoenia novemseptata (Roniewicz, 1966), nov. comb.

  Type material: holotype ZPAL no. HIII/183.
  Type locality: upper Oxfordian of Bukowa (Poland).

  Dimensions of the holotype: D = (4) 4.5-5 mm, c-c = 4-7 mm, septal formula = 9S1 + 9S2, Nc = 36.

  * 1966 Pseudocoenia novemseptata Roniewicz, p. 187, Pl. 5, fig. 1.

  Status: valid. Given the rare occurrence of this nonameral species, the question of a possible intraspecific variation of A. fromenteli is raised. However, due to its easy practical recognition, we keep it separate as morphospecies.

  Remarks: The species is well illustrated in Roniewicz (1966, p. 187, Pl. 5, fig. 1).

  Paleobiogeography of A. novemseptata: known only from Oxfordian of Poland.

5.4. Decameral species of Adelocoenia

  Adelocoenia maxima Beauvais, 1964

  Type material: holotype, NMB D4335 (coll. Bohny).
  Type locality: Upper Jurassic ("Séquanien") of Hofbergli near Günsberg (Switzerland).

  Dimensions of the holotype: D = 4-6 mm, c-c = 5-9 mm, Ns = 18-20, septal formula = 10S1 + 10S2, Nc = 40.

  ◀ Figure 32: Paleobiogeographical distribution of A. pistillum (Fromentel, 1861).

  ◀ Figure 33: Paleobiogeographical distribution of A. maxima Beauvais, 1964.
Figure 34: Syntype of "Cryptocoenia" ? incerta ACHIARDI, 1880 (Museum Pisa MSNUP I 2521).

v p 1881 Cryptocoenia cartieri Koby - Koby, p. 89, Pl. 22, fig. 5, non 3, non 4.
* 1964 Adelocoenia maxima BEAUVAIS, p. 119, Pl. 2, fig. 7; Pl. 4, fig. 1.
1966 Pseudocoenia maxima (BEAUVAIS) - RONIEWICZ, p. 188, Pl. 5, fig. 2.
non 1982 Pseudocoenia cf. maxima (BEAUVAIS) - Liao, p. 158, Pl. 6, figs. 2-3.
1987 Pseudocoenia maxima (BEAUVAIS) - KHUSANOV, p. 53, Pl. 2, fig. 1.

Status: valid.

Paleobiogeography of A. maxima (Fig. 33):
upper Oxfordian of Poland; upper Oxfordian-
lower Kimmeridgian of Switzerland, Uzbekistan;
lower Kimmeridgian of Poland.

5.5. Species of closely related genera transferred to genera other than Adelocoenia

Solenocoenia RONIEWICZ & GILL, 1976
• Adelocoenia bernensis BEAUVAIS, 1964, p. 118 (non Styliina bernensis THURMANN & ÉTALLON, 1864).
  • Convexastraea alveolata Koby, 1889, p. 470, Pl. 122, figs. 4-6.
  • Convexastraea weaveri GERTH, 1928, p. 8, Pl. 2, fig. 5.
  • Convexastraea digitiformis Koby, 1905b, p. 42, Pl. 7, figs. 1-4.
  • Convexastraea kiliani Koby, 1905a, p. 854, Pl. 54, fig. 1.
  • Convexastraea portlandica FROMENTEL, 1856, p. 859.
  • Convexastraea semiradiata ÉTALLON, 1864, p. 374, Pl. 52, fig. 10 (type species of Solenocoenia).
  • Cryptocoenia? incerta ACHIARDI, 1880, p. 298, Pl. 20, fig. 4 + p. 275 (Museum Pisa MSNUP I 2521). We provide here the first photograph of the syntype MSNUP I 2521 of this nominal species (see Fig. 34).
  • Cryptocoenia sublimbata ORBIGNY, 1850, p. 33.

• Cryptocoenia subregularis ORBIGNY, 1850, p. 33.
• Cryptocoenia thiessingi Koby, 1881, p. 86, Pl. 29, fig. 2.

Heliocoenia ÉTALLON, 1859
• Adelocoenia corallina ORBIGNY, 1850, p. 32.
• Adelocoenia moreana ORBIGNY, 1850, p. 33.

Styliina LAMARCK, 1816
The following species are transferred to the genus Styliina (with genus concept as recently proposed by ZAMAN & LATHUILIÈRE, 2018).
• Adelocoenia tubulosa ORBIGNY, 1850, p. 32.
• Cryptocoenia arduennensis ORBIGNY, 1850, p. 385.
• ? Holocoenia cesaredensis Koby, 1905b, p. 31, Pl. 5, fig. 10.

• Pseudocoenia bernardina ORBIGNY, 1850, p. 32 - WELLS (1936, p. 128) chose the specimen MNHN no. 4472 (excluding no. 4472a and b) of the ORBIGNY coll. as the lectotype of the type species of the genus Pseudocoenia (= Pseudocoenia bernardina). Today, two specimens exist in the MNHN collections which have the inventory numbers MNHN.F.A53891 and MNHN.F.R09199, both of which were originally also referred to the same number (4472). Hence, it is impossible to verify whether Wells was referring to either one of the specimens. Therefore, following the ICZN [Art. 74.5], WELLS’ lectotype designation is invalid. For this reason, we select the specimen MNHN.F.R09199 (hand specimen and thin section, Kimmeridgian of Landeyron, commune of Montréal-la-Cluse, Ain, France) as the lectotype of the species Pseudocoenia bernardina ORBIGNY, 1850. With regard to its characters, the specimen closely corresponds to the genus Styliina sensu ÉTALLON (1864). The paralelotype MNHN.F.A53891 (Kimmeridgian of Landeyron, Ain, France), belongs to Adelocoenia and is, therefore, here considered to be a junior synonym of Adelocoenia limbata (GOLDFUSS, 1829).
• Pseudocoenia elegans ORBIGNY, 1850, t. 2 – ORBIGNY, p. 34.
type from Günsberg exists in the Koby collection at Porrentruy under the number MJSN S1364, which is probably the specimen of fig. 5 on Pl. 22 in Koby (1881). Because the syntypes appear to belong to different taxa, we select here both the sample from the Koby collection in Basel NMB D 4334 as the lectotype and the specimen from the Koby collection in Porrentruy S1364 as a paralectotype. The type locality of the newly designated lectotype D4334: Oxfordian (Rauracian) of Fringeli, Switzerland.

- *Cyathophora dolfussi* Koby, 1907, p. 8, Pl. 4, fig. 24.
- *Cyathophora insignis* Duncan, 1872, p. 14, Pl. 1, figs. 9-11.

**Brachthelia Beauvais & Beauvais, 1975**

- *Pseudocoenia bangoensis* Liao & Xia, 1985, p. 137, Pl. 3, fig. 3.

**Clausastrea Obigny, 1849**

- *Cryptocoenia decupa* Obigny, 1850, p. 33.

### 5.6 Species of uncertain taxonomic position

- *Pseudocoenia ramosa* Obigny, 1850, p. 34 syntypes MNHN.F.A09455, MNHN.F.A09456, MNHN.F.A09457. Because the type material is unrecognizably preserved, we consider it a nomen dubium.

- *Convexastrea abadiensis* Geyer, 1955a, p. 325, Pl. 1, fig. 6. Thin section studies of the type specimen will be necessary in order clarify whether it belongs to *Adelocoenia* or *Solenocoenia*.

- *Adelocoenia gissarensis* Reiman, 1971, p. 100, Pl. 1, figs. 7-9. This species does not belong to *Adelocoenia*, because neither the budding mode nor both corallite shape and septal development are compatible with the genus *Adelocoenia*. The species needs to be revised.

- *Styлина (Convexastrea) hukawazaensis* Eguchi, 1951, p. 74. This species was transferred to *Adelocoenia* by Löser & Mori, 2002. However, in young corallites of the holotype (see Löser & Mori, 2002, Fig 1.7), a major septum is present, a feature which is unknown in *Adelocoenia*. Therefore, further investigation will be necessary to clarify the taxonomic position of the material.

- *Styлина (Convexastrea) hukawazaensis* Eguchi, 1951, p. 74. This species was transferred to *Adelocoenia* by Löser & Mori, 2002. However, in young corallites of the holotype (see Löser & Mori, 2002, Fig 1.7), a major septum is present, a feature which is unknown in *Adelocoenia*. Therefore, further investigation will be necessary to clarify the taxonomic position of the material.

- *Adelocoenia lanceloti* Obigny, 1850, p. 33. The lectotype MNHN.F.R09322 (designation in Cottreau, 1931) is an artificial mold, which does not seem to correspond to the description by Cottreau (1931, p. 154/22). According to Cottreau, the material is poorly preserved. He indicated, however, the presence of a columnella and suggested that the material belonged to a decameral species of *Styлина*. Because of both the discrepancy between the structures seen in the molid material and the description, and the poor preservation of the material, the taxonomic position of this species remains unclear.
Convexastraea orientalis Neumayr in Naumann & Neumayr, 1890, p. 30, Pl. 5, fig. 6. Løser and Mori (2002) suggested a possible synonymy with Solenocoenia semiradiata (Étallon). However, a revision of the material is necessary in order to clarify its skeletal structures, especially those of the endothea. At the present, the taxonomic status of this species remains uncertain.

Adelocoenia pseudosexradiata Alloiteau & Farrag, 1964, p. 62, Pl. 4, fig. 3. This species is probably a Solenocoenia, but a revision of the type material, which is housed in Cairo (Egypt), is necessary in order to clarify its taxonomic position.

Cryptocoenia baguieri Orbigny, 1850, p. 33. The species possibly belongs to Adelocoenia but because of the poor preservation of the material, its taxonomic position remains unclear.

Cryptocoenia haimei Tomes, 1881, p. 161. The type specimen was neither figured nor ever revis ed after its original description. A revision is needed to clarify the taxonomic position of the species.

Madrpora obeliscus Michelin, 1844, p. 112, Pl. 25, fig. 4. Because both the type material is lost and the description by Michelin is inconclusive, a taxonomic identification is impossible.

Cryptocoenia matskevici Krasnov & Starostina, 1970, p. 79, Pl. 4, fig. 5. Based on the original description of the material, it seems that the species lacks costae, thus differing from the genus concept of Adelocoenia. A revision is necessary to identify its taxonomic position.

Cryptocoenia ornata Orbigny, 1850, p. 385. The original description is most insufficient. In addition, the descriptions of the material by Orbigny (1850) and Milne Edwards and Haime (1857) contradict each other. Furthermore, the type material is lost. Therefore, the taxonomic position of the material cannot be determined.

Cryptocoenia plana Tomes, 1884, p. 707. The type specimen was neither figured nor ever revised after its original description. A revision is needed to clarify the taxonomic position of the species.

Cryptocoenia rigauxi Tomes, 1884, p. 707. The type specimen was neither figured nor ever revised after the original description. A revision is needed to clarify the taxonomic position of the species.

Convexastraea desori Koby, 1897, p. 30, Pl. 2, figs. 9-10. A revision is necessary to decide on the status of the species.

Adelocoenia minima Alloiteau & Farrag, 1964, p. 60, Pl. 4, fig. 1. A revision of the type material, which is housed in Cairo (Egypt), is necessary in order to determine its taxonomic position.

Adelocoenia minima Beauvais, 1964, p. 121, Pl. 4, fig. 2; Pl. 5, fig. 1. Because the taxon represents a junior homonym, it is unavailable. It seems that the dimensions of Koby's (1881) spe-

6. Stratigraphy and evolution

The first occurrence of the genus is represented by a single specimen known from the Sinemurian of France (see Fig. 36). The genus has not been recorded from the two following stages (Pliensbachian and Toarcian). This is remarkable given that extensive work on Pliensbachian and Toarcian faunas has just recently been published (Vasseur, 2018). From the Aalenian, Adelocoenia is known by a single occurrence from Chile. Even during the Bajocian, plocoid stylinsids were still quite uncommon. The real evolutionary success of the genus began in the Bathonian (possibly during the late Bajocian, a substage which is presently poorly documented). In the Bathonian, Adelocoenia is represented predominantly by hexameral species. The pinnacle of its success followed in the Late Jurassic. During the Oxфор-

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probably underestimated. This issue will be the subject of a separate work. At least three Jurassic nominal species have been reported from the lowermost Cretaceous: *A. parvistella*, *A. radisen-sis* and *A. hexaphyllia*.

**Paleobiogeography**

The paleobiogeographical patterns of the species are illustrated in the various maps presented above. As a general conclusion it can be stated that the distribution of *Adelocoenia* was marked by occurrences along the northern Tethys margin which, throughout the Jurassic, was characterized by ecological conditions favorable for reef development. The maps showing the paleobiogeographical patterns of *Adelocoenia* closely correspond to the paleomaps of reefal occurrences (e.g., KISSLING, 1999; LEINFELDER et al., 2002; CECCA et al., 2005; MARTIN GARIN et al., 2012). It should be noted, however, that these paleobiogeographical patterns are potentially biased by the nature of the collections with many European countries overrepresented. More information is needed, especially on material from regions such as paleoequatorial latitudes and the southern hemisphere. However, the distributional patterns of the species are illustrated in the various maps presented above.
shown on these maps lead to the following observations. First, the distribution is restricted to paleolatitudes of the shallow-water reef belt, suggesting a zooxanthellate nature for the genus, which would be consistent with its morphology. No Adelocoenia occurrence is known from areas in paleolatitudes higher than 40° (neither N nor S). More precisely, the occurrence of Adelocoenia in moderately high latitudes where eurytopic genera such as Isastrea Milne Edwards and Haime, 1851b, Thamnasteria Lesauvage, 1823, and Thecosmilia Milne Edwards, 1848, are well represented can probably be explained by a eurytopic nature comparable to the latter genera (Martin Garin et al., 2012, consider the collective distribution of the nominal genera Adelocoenia, Cryptocoenia and Pseudocoenia). Compared with the typical eurytopic genera, the distribution of Adelocoenia is probably more restricted due to local ecological conditions; in particular, the quasi-exclusive preference of Adelocoenia for lagoonal environments (Lathuillère et al., 2005, in which Adelocoenia is named erroneously Cryptocoenia). The genus is mainly Tethyan, often with a broad geographic distribution. Because only a few species of Adelocoenia are endemic, it is suggested that oceanic currents along the northern Tethys margin were very effective in species distribution. However, some rare occurrences have been recorded outside the Tethys, namely in Japan, Colombia and Chile. The occurrence of Adelocoenia with two species (A. castellum and A. parvistella) in the Upper Jurassic of Japan is also a significant fact in terms of geodynamic interpretation. The ecological requirements of Adelocoenia that are revealed by the paleomaps suggest that the Late Jurassic paleoposition of Japan was below the latitude of 35°. This hypothesis is in close accordance with the conclusions of Chalais et al. (2010, 2011) who suggested a Triassic paleoposition of Japanese Sambosan units in a paleoequatorial latitude.

7. Conclusions

- Based on the designation of a well-preserved neotype, the definition of the genus Adelocoenia is established. From that it can be concluded that its characters closely correspond to the traditional taxonomic concepts of the genera Cryptocoenia sensu Kobay (1881, 1889) and Pseudocoenia sensu Roniewicz (1966) non sensu Wells (1936).
- The placement of Adelocoenia within the family Stylinidae is confirmed.
- Many Jurassic species of the genus are revised resulting in a more detailed view of the history of the genus. Many other plocoid species are reclassified and grouped with other genera (e.g., Stylna, Heliocoenia? Solenocoenia) for which their synonymies should be updated.
- Several plocoid species remain to be revised based on the newly established characterizations of type material of the genera dealt with in the current paper. Special attention should be given when evaluating species currently assigned to Solenocoenia for which longitudinal sections are often necessary in order to identify the two-zoned endothea. The presence of canals in Solenocoenia connecting the corallites is not considered to be of taxonomic value.

- The genus Adelocoenia had its first occurrence in the Sinemurian. The pinnacle of its success, in terms of biomass production, species diversity and morphological disparity, was in the Late Jurassic. The last occurrence of Adelocoenia is in the Cretaceous for which a detailed revision of species is in preparation.
- The occurrence of Adelocoenia mostly occurred in inner platform environments of low latitudes.
- The occurrence of Adelocoenia from the Upper Jurassic of Japan strongly supports the hypothesis that the paleoposition of Japan during the Late Jurassic was at latitudes not higher than 35° N.

Acknowledgments

Type material and additional study material was made accessible to us by Walter Etter, Olivier Schmidt and Sergio Kühl (Naturhistorisches Museum Basel, Switzerland), Georg Friebe (“Inatur”, Dornbirn, Austria); Heinz Fur rer (University of Zurich, Switzerland), Ursula Menkved-Gfeller (Natural History Museum, Bern, Switzerland), Peter Kürsteiner and Karl Tschanz (both Naturmuseum St. Gallen, Switzerland), Jacques Ayer (Musée Jurassien des Sciences naturelles, Porrentruy, Switzerland), Pierre Alain Proz and Lionel Cavín (Musée d’Histoire naturelle de Genève, Switzerland), Andreas Kroh, Alexander Luke-Neder, Oleg Mandic, and Thomas Nichterl (all Natural History Museum, Vienna, Austria), Helena Eliásová (Prague, Czech Republic), Elżbieta Morycowa (University of Krakow, Poland), Michael Rick der (Senckenberg Research Institute, Frankfurt/Main), Robin Marchant (Lausanne, Switzerland), Ewa Roniewicz (Academy of Sciences, Warsaw, Poland), Winfried Werner, and Martin Nose (both Bayerische Staatsammlung, Munich, Germany), Günther Schweigert (Staattisches Museum für Naturkunde, Stuttgart, Germany), Sandra Kaiser and Georg Heumann (Institut für Paläontologie, Bonn), Chiara Sorbini (Museo di Storia Naturale, Universita di Pisa, Calci, Italy), Jill Darrell (The Natural History Museum, London, UK), Dhirendra Khumar Pandey for photos of a specimen hold in Rajasthan University collections in Jaipur (India). Dennis Opresko (Knoxville, Tennessee) is gratefully acknowledged for his help regarding linguistic issues of the manuscript. We are thankful to Philippe Bouchet for a decisive phone conversation about nomenclature at a very early stage of this work when we were still hopeful that we could preserve the usage of the name Pseudocoenia. We are also indebted to Rossana Martini (Geneva, Switzerland) for discussion on paleo-geography and to Séverin Moré (CR2P, MNHN)
for making the excellent thin sections of the type material at MNHN.

As a Research Associate of the Smithsonian Institution (SI) Washington, DC, USA, and an Honorary Researcher at the Research Institute Senckenberg, Frankfurt/Main, Germany, one of the authors (RBS) would like to express her deep appreciation for the continuing support from the institutions.

This work benefited from a grant of the French state managed by the Agence Nationale de la Recherche via the programme 'Investissements d'avenir' (ANR-11-INBS-0004-RECOLNAT).

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T. S. S. S. T. S. S. S. T. S. R. S. HOMAS HÉVENIN TRUCKMANN TAROSTINA PEYER OLOMKO CHÖNDORF OSENDAHL ONIEWICZ

Annales de Paléontologie

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aus dem Institut für Geologie und Paläontolo-

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