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A NEW SUBSPECIES OF *CUPULADRIA CAVERNOSA* CADÉE FROM THE PLIOCENE OF WESTERN EMILIA (N. ITALY)

(Bryozoa Gymnolaemata Cheilostomatida Cupuladriidae)

Riassunto

[*Una nuova sottospecie di* Cupuladria cavernosa *Cadée (Bryozoa, Cheilostomatida) nel Pliocene dell'Emilia occidentale (Italia)*]
In tre affioramenti pliocenici dell'Emilia occidentale sono state trovate numerose colonie di *Cupuladria cavernosa* Cadée che si discostano per alcuni caratteri dalla forma tipica della specie. Le differenze più evidenti, che le colonie di queste tre popolazioni esibiscono rispetto ai caratteri tipici di *C. cavernosa*, sono la presenza costante nella parte mediana o mediodistale dell'opesio di due lunghi dentelli, prodotti dal criptocisti, e una distribuzione più irregolare delle camere e dei settori nella regione centrale del disco basale. Non essendo mai stata segnalata la presenza dei due lunghi dentelli del criptocisti in *C. cavernosa* ed essendo questo diverso morfotipo presente con numerosi zoari, si è ritenuto necessario separare queste colonie da *C. cavernosa* ed istituire per loro la nuova sottospecie *Cupuladria cavernosa placentina*. Queste popolazioni di *Cupuladria cavernosa placentina* n. subsp. sono state trovate nei sedimenti del Piacenziano affioranti nella cava di Campore a Salsomaggiore Terme (PR) ed in quelli delle sezioni di Monte Padova e Monte Falcone di Castell'Arquato (PC). Nelle popolazioni plioceniche di *Cupuladria cavernosa* Cadée di molte altre località dell'Emilia si possono trovare colonie con zooeci che mostrano i due dentelli del criptocisti, ma questi quando presenti sono minimamente estesi ed applicati in pochi zooeci. La presenza in queste popolazioni rinvenibili in Emilia di *C. cavernosa* dei due dentelli, anche se poco frequenti e di dimensioni minori, non consente di separare a livello specifico questo diverso morfotipo dalla forma tipica, ma permette però di supporre che probabilmente nel Pliocene si stava compiendo un tentativo di speciazione, forse non riuscito completamente, che proponeva, con l'accentuazione di alcuni caratteri della specie madre, uno sviluppo zooeciale quasi omeomorfo a quello di *Cupuladria bugei* Galopim de Carvalho.

Abstract

Many colonies of *Cupuladria cavernosa* Cadée, which are different from the typical morphospecies in some characters, have been found in three Pliocene outcrops of the Western Emilia area. The differences, which divide the colonies of these populations from *C. cavernosa*, are

the constant presence of two long denticles in the central region of the opesia, which are produced by the cryptocyst, and a more irregular distribution of the chambers and sectors in the central region of the zoarial basal disk. For the two long cryptocystal denticles that have not been observed to be present in *C. cavernosa*, it is necessary to separate these colonies from *C. cavernosa* and to define a new subspecies with the name *Cupuladria cavernosa placentina*. The colonies of *C. cavernosa placentina* n. subsp. have been found in the sediments cropping out in the Campore quarry near Salsomaggiore Terme (Parma Province) and in those of the Monte Padova and Monte Falcone sections to Castell'Arquato (Piacenza Province); sediments of these three outcrops are Piacenzian in age.

Key words: Bryozoa, Cheilostomatida, *Cupuladria cavernosa placentina* n. subsp., Pliocene, Emilia.

Introduction

CADÉE (1979) considered his *Cupuladria canariensis cavernosa* to contain many European and Mediterranean fossils ascribed by previous authors to *Cupuladria canariensis* (Busk) and *Cupuladria biporosa* Canu & Bassler. This subspecies of Cadée has been given a species range by COOK & CHIMONIDES (1994) and was furthermore regarded as a senior synonym of *Cupuladria vindobonensis* Baluk & Radwanski (COOK & CHIMONIDES, 1994). Cadée marked off his *C. canariensis cavernosa* from his two other subspecies *C.c. canariensis* and *C.c. surinamensis* due to the fact that it « Differs from the foregoing subspecies by the presence of more than one layer of basal kenozooecia resulting in a thicker layer of basal calcification of the zoarium, by its finely granular basal surface, its more developed and more gently descending cryptocyst. The average number of basal pores per sector (4.5–8.1) is somewhat lower than in *C. canariensis canariensis*, but some populations have a relatively high number of pores (Fécamp, Palluau). Variation observed in number of pores is large: 1–28. The basal kenozooecial pores are relatively small. Vicarious vibracula not observed. ». In practice he considered it as a geographical-temporal subspecies of *Cupuladria canariensis*, occurring in the Mio-Pliocene of Europe and the Mediterranean basin. Subsequently, COOK & CHIMONIDES (1994) described *Cupuladria cavernosa* Cadée as « Colonies medium sized, diameter up to 12 mm. Autozooidal cryptocyst slightly curved to straight laterally; lateral septulae not visible. Zooidal avicularia monomorphic, vicarious avicularia present, but rare, in some populations only; gymnocyst long, opesia auriform to rounded. Basal sectors very variable, with 4–10 (usually 4–8) chambers per sector, chambers up to 6 in a vertical series. ». The remarks of CADÉE (1979) and COOK & CHIMONIDES (1994) suggest that *C. cavernosa* is a polytypical species showing a great morphological variability.

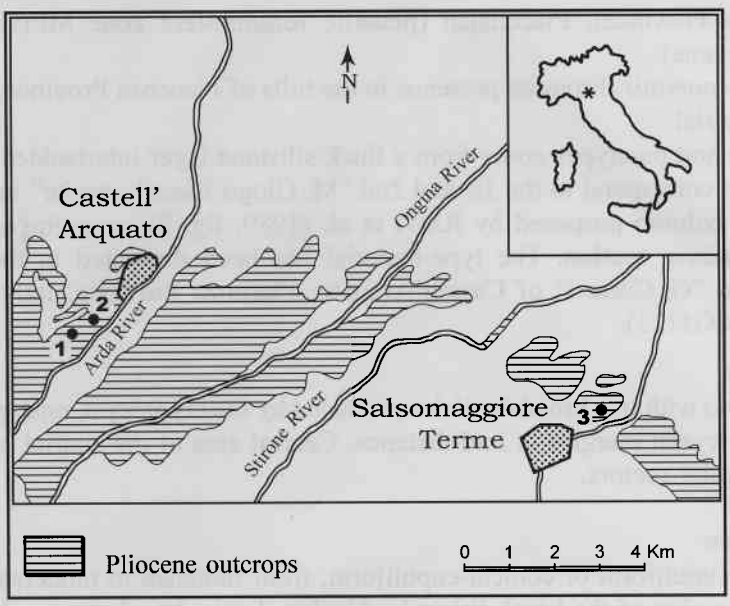

Fig. 1 - Location of the outcrops containing *Cupuladria cavernosa placentina* new subsp. in the Western Emilia region: 1 – Monte Padova section; 2 – Monte Falcone section; 3 – Campore quarry.

The Neogene sediments, cropping out in the Western Emilia area, often contain faunas in which *C. cavernosa* is present, but always with moderate presence. In these faunas, the characters occurring in the colonies of this species are usually constant but, in a few of these assemblages, *C. cavernosa* is also present with many colonies in which the zooecia have the opesium partially occupied by a long laminar denticle on both sides, which is produced by the cryptocyst. The abundance of these colonies, which also differ from the typical specimens of *C. cavernosa* in cryptocyst width and in the sectors of the central basal disk, allows us to recognize the existence of a speciation attempt in the populations of the Po Basin during the Pliocene. These colonies, separable from the typical ones, have to be regarded as belonging to a subspecies of *C. cavernosa* because, with the actual knowledge on their distribution and frequency, we have to regard that they presumably did not reach a complete reproductive isolation to attain the critical level of speciation.

Taxonomic account

Cupuladria cavernosa placentina n. subsp.

Locus typicus: Monte Padova section cropping out near Castell'Arquato

(Piacenza Province), Piacenzian (planktic foraminifera zone MPl5a) in age (mid-Pliocene).

Derivatio nominis: From its presence in the hills of Piacenza Province, Italy.

Type material

Holotype and paratypes come from a thick siltstone layer interbedded between strata that correspond to the 1st and 2nd "M. Giogo Biocalcarenite" in the stratigraphic column proposed by RAFFI et al. (1989, fig. 2), cropping out in the Monte Padova section. The type-material has been deposited in the Museo Geologico "G. Cortesi" of Castell'Arquato, Piacenza Province, Italy (sample number MG1123).

Diagnosis

Cupuladria with two broad denticles produced by the cryptocyst, emerging from the cryptocystal margins at mid-distance. Central area of the zoarial basal disk with irregular sectors.

Description

Zoarium cupuliform or conical-cupuliform, from flattened to moderately high. Perimetric edge of the basal disk suborbicular, denticulate due to projection of the peripheral zooecia. Zooecia in alternating radial series, each with a avicularium (vibraculum) at the distal vertex. Basal surface variably concave, with radial and transversal grooves determining radially elongated, rectangular or trapezoidal sectors, each sector usually containing 5 to 12 suborbicular chambers which are normally arranged in two rows; tubercular protuberances may be present. Basal calcification gradually closes the chambers and a new one is successively formed which communicates with the preceding one by a small subcen-

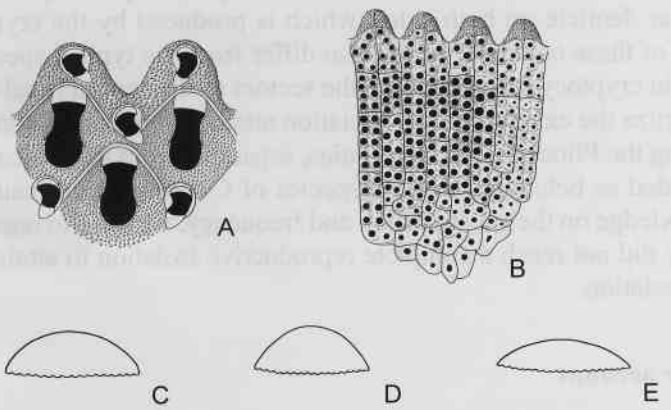

Fig. 2 - *Cupuladria cavernosa placentina* new subsp.: A – Frontal view of zooecia; B – Sectors and chambers in zoarial basal surface; C, D, E – Zoarial outlines.

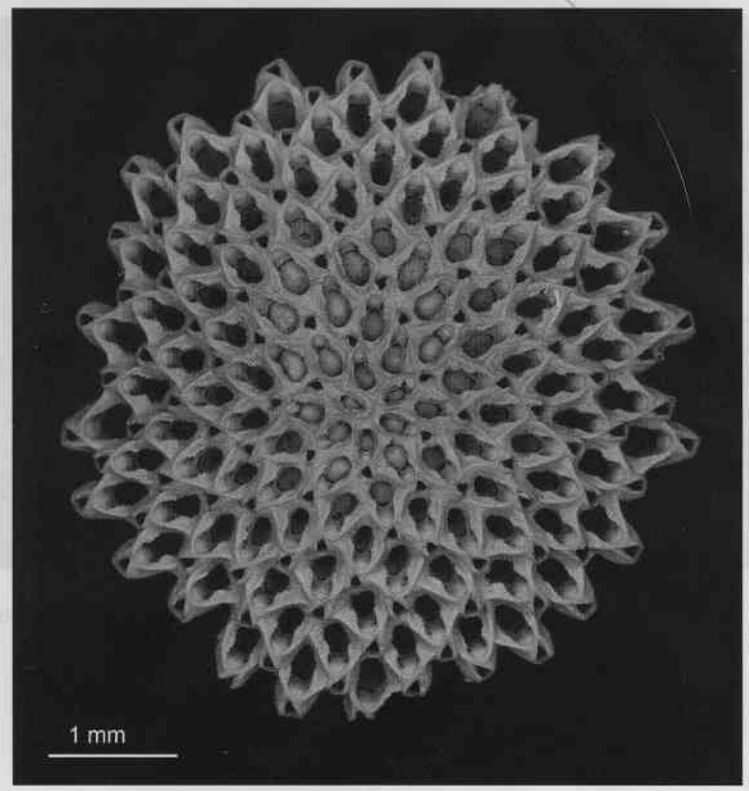

Fig. 3 - *Cupuladria cavernosa placentina* new subsp.: Holotype (MG1123), Monte Padova section.

tral pore. Sectors in the central part of the basal disk are of irregular shape and contain only one or very few pore chambers; in this region large subglobular thickenings are sometimes produced, penetrated by pores of various size. Surface of sectors finely granulate, being coarser in the central region, and often with more or less raised tubercles. Sectors initially separated by deep distinct grooves, becoming shallower and less distinct with increasing secondary calcification.

Zooecia subrhombic. Vertical walls raised and finely granulated, penetrated by a linear series of small interzooecial pores, the perimetrical region of basal walls is perforated by a linear series of communication pores. Vestibular arc (sensu COOK, 1965a: 154; CADÉE, 1977: 444) with a raised edge, often acute, sometimes thickened and crescentic, and with non-convergent sides. Cryptocyst granulated, very steep or almost vertical in the proximal region, gently descending distally and, on both sides of opesia, forming a broad, subtriangular or curvilinear, laminar denticle, with a granular to finely saw-toothed rim, situated just

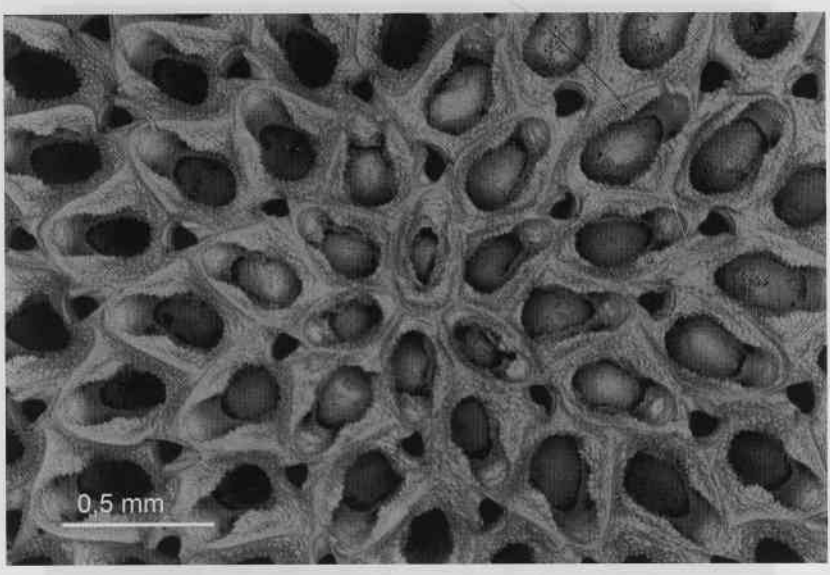

Fig. 4 - *Cupuladria cavernosa placentina* new subsp.: zooecia of central region in holotype.

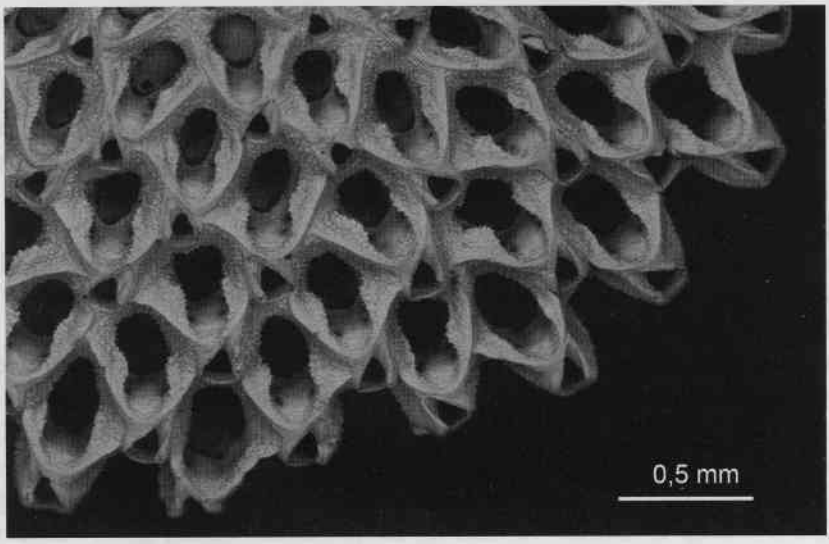

Fig. 5 - *Cupuladria cavernosa placentina* new subsp.: peripheral zooecia in holotype.

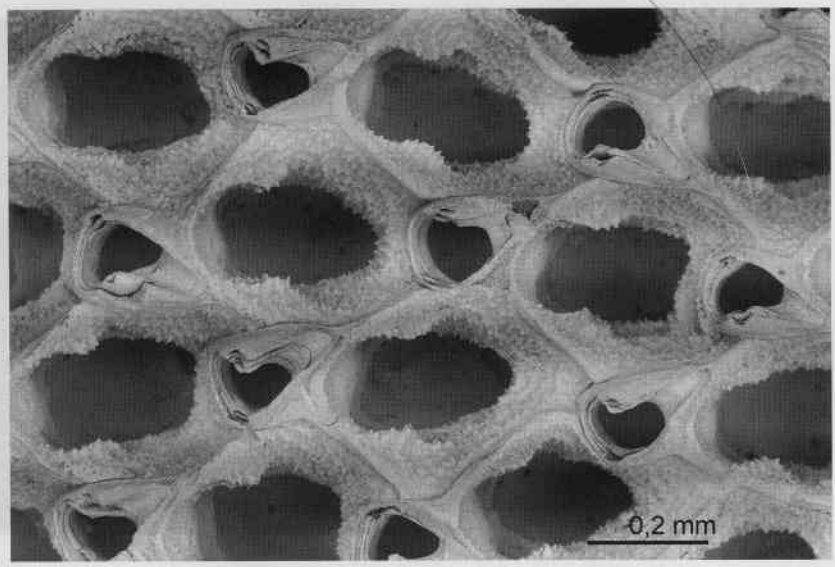

Fig. 6 - *Cupuladria cavernosa placentina* new subsp.: general aspect of zooecia and avicularia (vibracula) in a colony from the Monte Padova section.

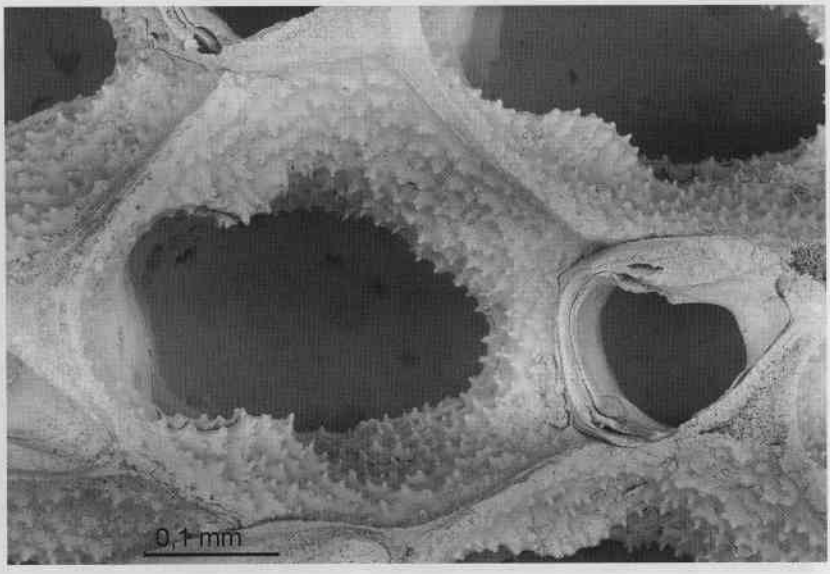

Fig. 7 - *Cupuladria cavernosa placentina* new subsp.: single zooecium of the same colony as in Fig. 6.

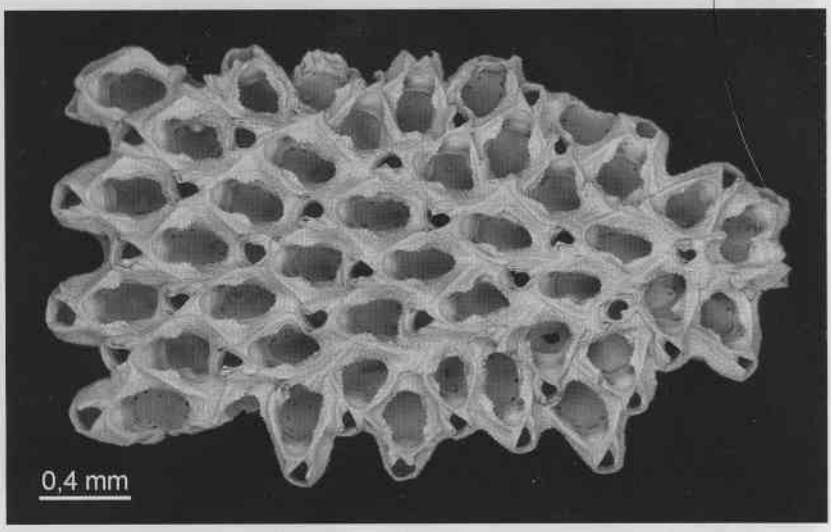

Fig. 8 - *Cupuladria cavernosa placentina* new subsp.: new zoarium produced by regeneration of a zoarial fragment (Monte Padova section).

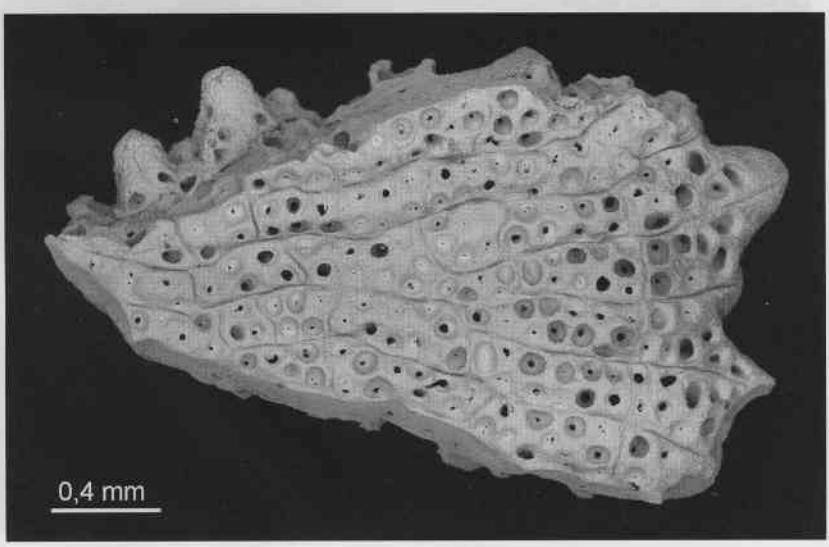

Fig. 9 - *Cupuladria cavernosa placentina* new subsp.: basal surface of the same zoarium as in Fig. 8.

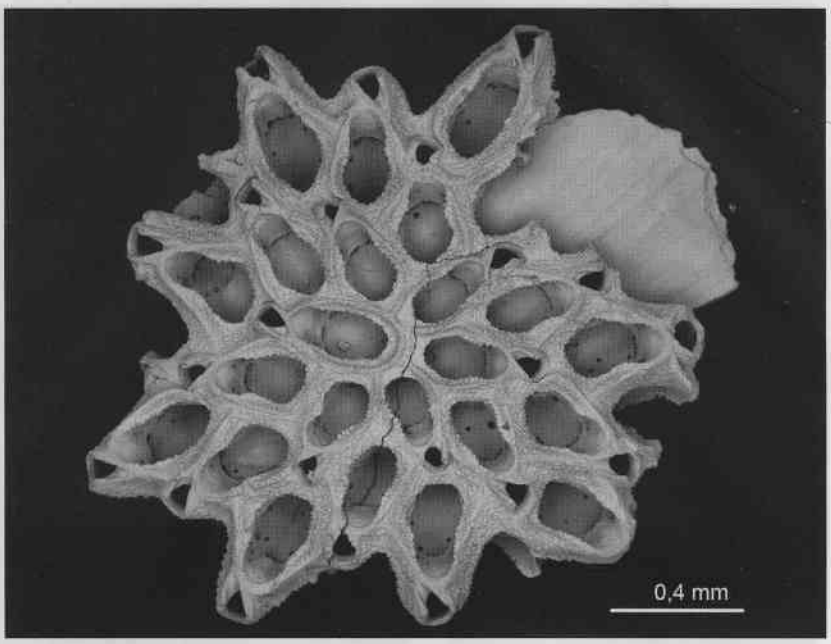

Fig. 10 - *Cupuladria cavernosa placentina* new subsp.: young colony (Monte Padova section).

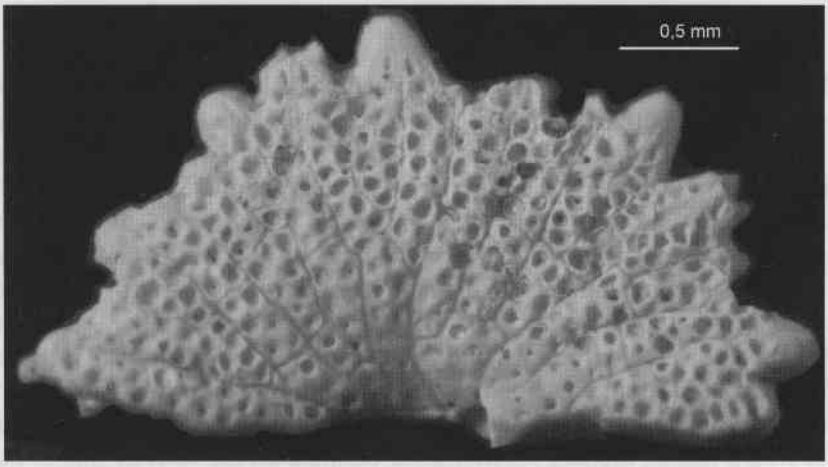

Fig. 11 - *Cupuladria cavernosa placentina* new subsp.: zoarial basal surface in a fragment of colony from the Monte Padova section.

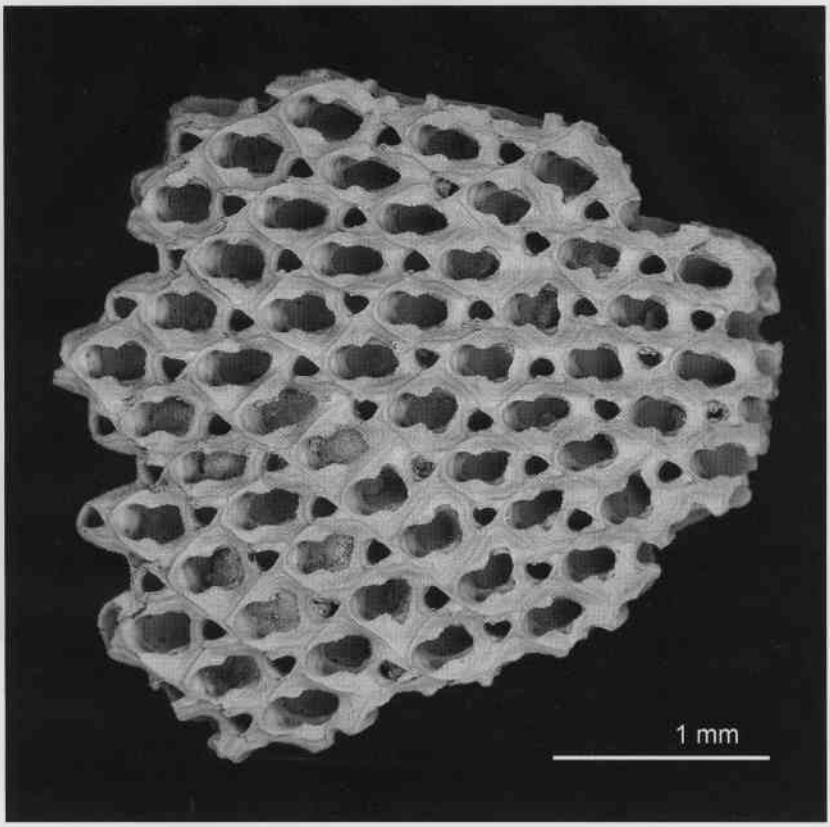

Fig. 12 - *Cupuladria cavernosa placentina* new subsp.: fragment of a colony from the Campore quarry.

distal to mid-distance of opesia, usually occupying half of opesia length. When large and projecting the two denticles produce a bifoliate opesia. Early astogeny with zooecial proliferation as that proposed by LAGAAIJ (1963: 183, text fig. 10) in *Cupuladria canariensis* (Busk), and COOK (1965a: 155, text fig. 1B) for Cupuladriidae. Ancestrula surrounded by seven zooecia and one avicularium. Astogenetic change reflected by an increase in autozooid and avicularium dimensions. During astogeny the first three zooecia and many of the periancestrular zooecia become partially obstructed by granular secondary calcification, which is added to the cryptocyst and to the interior of vertical walls; this calcification produces a funnel-shaped depression in the zooecia with a fissure at its lower apex. Avicularium (vibraculum) with auriform opesia, palate subtriangular and with a raised, arched, subtriangular denticle on the convex side of its rim. Vicarious avicularia (vibracula) were not observed. Occasionally, greatly enlarged avicularia are present in colonies emanating from regenerated zoarial frag-

ments, replacing the normal avicularia.
Development of new zoaria by regeneration of colony fragments is often observed in this species. Some zooecia in regenerated colonies may have two or sometimes three vestibular arcs in their opesia, each with a avicularium.

Morphometry. Zooecial dimensions:

in early astogeny:	length	0.30 – 0.38 mm
	width	0.22 – 0.26 mm
in later astogeny:	length	0.38 – 0.43 mm
	width	0.30 – 0.38 mm

Remarks
The presence of broad and laminar denticles has not been reported in *Cupuladria cavernosa* Cadée before. Similarly distinct laminar denticles are present only in colonies of *Cupuladria bugei* Galopim de Carvalho in Pliocene faunas from the eastern Atlantic and Mediterranean Sea (Pizzaferri & Berning, work in progress). However, *C. c. placentina* from Western Emilia differs from *C. bugei* in that the former has:

a) greater zooecial dimensions;
b) more regular disposition and a different shape of the basal disk sectors;
c) greater number of chambers in every sector;
d) different position and usually also a different number of the denticles (always two in *C. c. placentina*, often three in *C. bugei*);
e) zooecia in the central region less affected by secondary calcification;
f) lower zoarial profile.

Other populations of *Cupuladria cavernosa* from the Emilia area contain colonies in which there is the tendency to reduce the size of the opesia due to secondary calcification of the cryptocyst in the distal part. A few of these colonies have zooecia with two small and long denticles projecting from the lateral cryptocyst, but these are smaller than those in *C. cavernosa placentina*, and only a few are present in each colony. The tendency of zooecia of *C. cavernosa* from the Po Basin to occupy the opesia with small but broad denticles formed by the cryptocyst, and the modifications occurring in *C. cavernosa placentina*, may be an expression of a speciation attempt in the Pliocene, perhaps not succeeding completely. Possibly, environmental conditions favored the development of almost homeomorphous characters, as concerns similarities of the cryptocyst between *C. c. placentina* and *C. bugei*, while at the same time accentuating some characters of the mother species regarding the cryptocystal denticles and the irregular sectors in the basal disk.

Distribution in the western Emilia area
Piacenza Province: Monte Padova and Monte Falcone sections, Castell'Arquato.
Parma Province: Campore quarry, Salsomaggiore Terme.
All of the sampled sedimentary successions are Piacenzian in age. Although *C. cavernosa placentina* is present in all three outcrops, it can be found frequently only in the Monte Padova section.

Ecology. Free form in adult stage, characteristic of soft particulate bottoms (silty or sandy muds) in the circalittoral.

Stratigraphic distribution. Piacenzian (mid-Pliocene).

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References

BALUK W. & RADWANSKI A., 1977 – The colony regeneration and life habitat of free-living bryozoans, *Cupuladria canariensis* (Busk) and *C. haindingeri* (Reuss), from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Poland). *Acta Geologica Polonica*, Warszawa, 27 (2): 143–156.

BALUK W. & RADWANSKI A., 1984a – Free-living bryozoans from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Poland). *Acta Geologica Polonica*, Warszawa, 34 (3-4): 239–251.

BALUK W. & RADWANSKI A., 1984b – Middle Miocene (Badenian) free-living bryozoans from the Vienna Basin. *Ann. Naturhist. Mus. Wien*, Wien, 86: 13–40.

BISHOP J.D.D. & HAYWARD P.J., 1989 – SEM Atlas of type and figured material from Robert Lagaaij's "The Pliocene Bryozoa of the Low Countries" (1952). *Meded. Rijks. Geol. Dienst.*, 43 (2): 1–64.

BUSK G., 1859 – A monograph of the fossil Polyzoa of the Crag. *Palaeontographical Soc.*, 14: 1-136.

CADÉE G.C., 1979 – The *Cupuladria canariensis* complex. In: G.P. Larwood & M.B. Abbott (eds.), Advances in Bryozoology. *Academic Press*, London: 443-460.

COOK P.L., 1965a – Notes on the Cupuladriidae (Polyzoa, Anasca). *Bull. British Mus. (Nat. Hist.) Zool.*, London, 13 (5): 151-187.

COOK P.L., 1965b – Polyzoa from West Africa the Cupuladriidae (Cheilostomata, Anasca). *Bull. British Mus. (Nat. Hist.) Zool.*, London, 13 (6): 189-227.

COOK P.L., 1968 – Bryozoa (Polyzoa) from the coast of tropical West Africa. *Atlantide Report*, Copenhagen, 10: 115-262.

COOK P.L. & CHIMONIDES P.J., 1994 – Notes on the family Cupuladriidae (Bryozoa), and on *Cupuladria remota* sp. n. from the Marquesas Islands . *Zoologica Scripta*, 23 (3): 251-268.

GALOPIM DE CARVALHO A.M., 1965 – Sur une espèce nouvelle de Bryozoaire (*Cupuladria bugei*) du Pliocène portugais. *Boletim da Sociedade Geologica de Portugal*, Lisboa, 16: 155-157.

HÅKANSSON E., 1973 – Mode of Growth of the Cupuladriidae (Bryozoa, Cheilostomata). In: G.P. Larwood (ed.): Living and Fossil Bryozoa, *Academic Press*, London: 287-298.

LAGAAIJ R., 1952 – The Pliocene Bryozoa of the Low Countries and their bearing on the marine stratigraphy of the North Sea region. *Mededel. Geol. Sticting.*, Ser. C, 5: 1-233.

LAGAAIJ R., 1953 – The vertical distribution of the lunulitiform Bryozoa in the Tertiary of the Netherlands. *Mededel. Geol. Stichting.*, n.s., 7: 13-19.

LAGAAIJ R., 1963 – *Cupuladria canariensis* (Busk) – portrait of a bryozoan. *Palaeontology*, 6: 172-217.

MONEGATTI P., RAFFI S. & RAINERI G., 1997 – The Monte Falcone - Rio Riorzo composite section: biostratigraphic and ecobiostratigraphic remarks. *Boll. Soc. Paleont. Ital.*, Modena, 36: 245-260.

MONEGATTI P., RAFFI S., ROVERI M. & TAVIANI M., 2001 – One day trip in the outcrops of Castell'Arquato Plio-Pleistocene Basin: from the Badland of Monte Giogo to the Stirone River. Int. Conference Paleobiogeography & Paleoecology, Piacenza & Castell'Arquato (Italy), May 31-June 2 2001, Excursion Guidebook, 26 pp..

POLUZZI A., 1975 – I Briozoi cheilostomi del Pliocene della Val d'Arda (Piacenza, Italia). *Memor. Soc. It. Sc. Nat. e Mus. Civ. St. Nat.*, Milano, 21 (2): 1-77.

RAFFI S., RIO D., SPROVIERI R., VALLERI G., MONEGATTI P., RAFFI I. & BARRIER P., 1989 – New stratigraphic data on the Piacenzian stratotype. *Boll. Soc.Geol. It.*, 108: 183-196.

REGUANT S., 1993 – The Cheilostome Bryozoa from the Huelva Pliocene (SW Spain) in the Western Mediterranean context. *Memorie di Scienze Geologiche*, Padova, 45: 125-138.

ROSSO A., 1996 – Lunulitiforms and their autoecology. *Boll. Soc. Paleont. Ital.*, Vol. Spec. 3, "Autoecology of selected fossil organism: Achievements and problems", Modena: 175-190.

WEISBORG N.E. 1967 – Some Late Cenozoic Bryozoa from Cabo Blanco, Venezuela. *Bull. of American Palaeontology*, 53 (237): 1-247.

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