

## A NEW SPECIES OF *SCOLECHINUS* (ECHINOIDEA) FROM THE EOCENE OF ITALY

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### ABSTRACT

Three small regular echinoids recently collected from the upper Eocene (Priabonian) of Sossano, in the Berici Hills near Vicenza (north-eastern Italy), are assigned to *Scolecchinus sossanensis* n. sp. The new taxon is distinguished from *Scolecchinus dallonii* Lambert in Lambert & Thiéry, 1925, the type species of the genus, by different test ornamentation and larger peristome. In particular, the ornamentation consists of epistomal ridges starting from the base of the primary tubercles and extending towards the adjoining ambulacral and interambulacral series. In *S. dallonii* the ornamentation is denser and made of shorter ridges mainly disposed longitudinally. Since *S. dallonii*, the sole species so far known of this rare genus, has been recorded only from the Oligocene of Algeria, this is the oldest record of the genus *Scolecchinus*.

**Key words:** Echinoidea, Trigonocidaridae, new species, upper Eocene, Italy.

### RIASSUNTO

#### UNA NUOVA SPECIE DI *SCOLECHINUS* (ECHINOIDEA) NELL'EOCENE ITALIANO

Tre piccoli echinoidi regolari raccolti nell'Eocene superiore (Priaboniano) della cava di Sossano nei colli Berici (Vicenza) vengono assegnati a *Scolecchinus sossanensis* n. sp. Il nuovo taxon si distingue da *Scolecchinus dallonii* Lambert in Lambert & Thiéry, 1925, la specie tipo del genere, per la diversa ornamentazione della teca e per il peristoma decisamente più grande. In particolare, l'ornamentazione è costituita da creste che si diramano dalla base dei tubercoli primari e si estendono sino ai tubercoli delle serie interambulacrali e ambulacrali adiacenti. In *S. dallonii* l'ornamentazione è più densa e prevalentemente direzionata in senso longitudinale oppure è costituita da creste corte e non iso-orientate. Dal momento che *S. dallonii* è l'unica specie sinora nota di questo genere ed è stata citata solo nell'Oligocene dell'Algeria, gli esemplari di Sossano rappresentano la testimonianza più antica di questo genere.

**Parole chiave:** Echinoidea, Trigonocidaridae, nuova specie, Eocene superiore, Italia.

### INTRODUCTION

Temnopleuroid echinoids are rather rare in the European Eocene. Being usually restricted to small corona diameters these echinoids are often overlooked in outcrops, especially where preserved as fragments. Contrary to other larger "regular" echinoids, however, their corona is quite sturdy and thus frequently preserved even in coarse grained deposits. Unfortunately, their remains are often abraded and susceptible to overgrowth by calcitic cement, which hides fine morphological details. Additionally, a large intraspecific variability affects the test ornamentation, which represents the most important distinctive character in these echinoids (JEFFERY & EMLET, 2003). Consequently, the taxonomy of these echinoids is partially unresolved and single specimens are often difficult to identify both at generic and specific level (PHILIP, 1969). Two new species have been described from the Eocene of north-eastern Italy: *Coptechinus italus* Oppenheim, 1902, and *Coptechinus bitneri* Dainelli, 1915. Since they were based on a few, not well preserved, specimens, their morphology is not completely known and attribution at the generic level is uncertain. The new material from Sossano (Berici Hills, Veneto Region) enables a comple-

te description and comparison with the two species of *Coptechinus* recorded from the same area and with the other known temnopleuroids.

### MATERIAL AND METHODS

The fossil material under study originated from the quarry of Sossano, in the Berici Hills near Vicenza (north-eastern Italy). It consists of three complete specimens, housed at the Museo Civico "D. Dal Lago" of Valdagno (Vicenza Province): the holotype (MCV 21/173) and two paratypes (MCV 21/49 and MCV 21/174). Two of them, including the holotype, preserve the apical system. The largest specimen (MCV 21/49) is partially deformed by lateral compression.

The holotype of *Scolecchinus dallonii* Lambert, 1925, is housed at the Muséum National d'Histoire Naturelle of Paris (Lambert collection); finding locality: upper Oligocene, of Ravine between Koursi and the road to Montgolfer, Algeria; D = 12 mm.

Morphological abbreviations. D = corona diameter measured at the ambitus; Da = diameter of the apical disc; Dp = diameter of the peristome, Dc = diameter of the

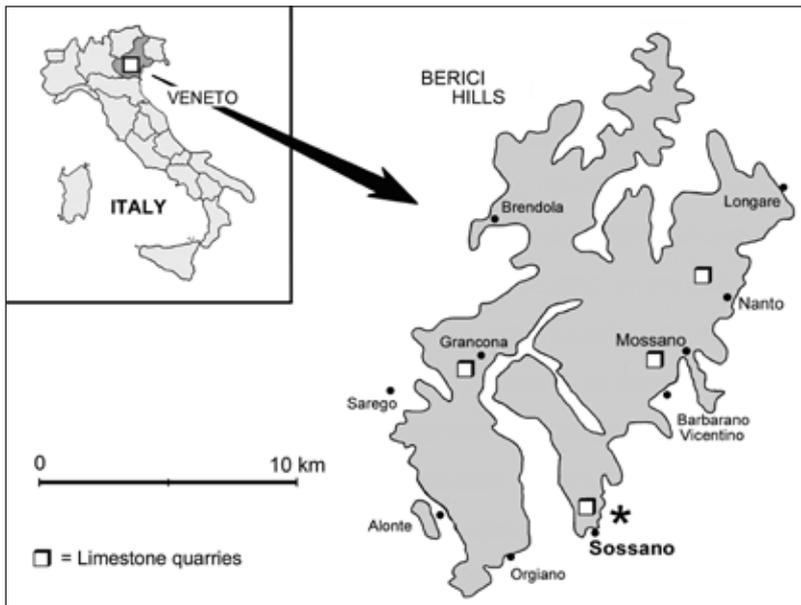


Fig. 1 - Location map of the quarry of Sossano (Vicenza Province), the finding locality.

periproct; nA, nIA = respectively number of plates in the ambulacral and interambulacral columns; TH = height of the test; WA, WIa = respectively width of an ambulacral and an interambulacral zone, measured at the ambitus. The systematics follows KROH & SMITH (2010) and KROH & MOOI (2022).

#### Finding locality

The specimens under study were collected by one of the authors (F.C.) and Fiorenzo Zamberlan (Museo Civico “Zannato”, Montecchio Maggiore, Vicenza) in the inactive quarry of Sossano, in south-eastern Berici Hills (fig. 1). Notwithstanding the environmental restoration occurred at the end of the extractive activity, the Eocene

section, about 50 m thick, is still well visible (fig. 2). It consists mainly of middle Eocene (Lutetian) calcareous limestones, which were utilised in concrete production, overlaid by about 8 m thick upper Eocene (Priabonian) grey marly limestones (DE ANGELI & CAPORIONDO, 2009). The marly limestones are well stratified and become yellowish when weathered. They are rich in macrofossils, consisting above all of nummulites, bryozoans and, less frequently, bivalves, crustaceans, fish tooth and echinoids. Also the temnopleuroids under study were collected in the uppermost marly limestones.

Geostratigraphy and paleoenvironments of the Eocene deposits in the Berici Hills have been studied by FABIANI (1908, 1915), UNGARO (1978) and MIETTO (1988, 2003). A paleosinecological analysis of the community present in an upper Eocene level rich in the annelid polychaete *Rotularia spirulea* Lamarck, 1818, at Sossano, has been provided by ACCORSI BENINI *et al.* (1988).

#### Previous work

The taxonomy in the infraorder Temnopleuridea Kroh & Smith, 2010 is still partially uncertain. A number of genera and species have been recently renamed. This was the case with *Temnechinus lineatus* Duncan, 1877, which became (JEFFERY & EMLET, 2003) the type species of the genus *Ortholophus* Duncan, 1887, and *Brochopleurus* Fourtau, 1920, which is currently considered a junior synonym of *Ortholophus* in SMITH & KROH (2011) and KROH & MOOI (2022).



Fig. 2 - Panoramic view of the quarry of Sossano. White arrows indicate the uppermost grey marly limestones (Priabonian).

*Scolecchinus* Lambert in Lambert & Thiéry, 1925 was considered by MORTENSEN (1943) as a probable junior synonym of *Brochopleurus* and, as a consequence, of *Ortholophus*.

Also three species from the Miocene of Australia instituted by ancient Austrian researchers, *Psammechinus woodsi* Laube, 1869, *Coptechinus lineatus* Bittner, 1892 and *Coptechinus pulchellus* Bittner, 1892, have been transferred (JEFFERY & EMLET, 2003) to the genus *Ortholophus* and are actually accepted in KROH & MOOI (2022) respectively as *Ortholophus woodsi* (Laube, 1869), *O. bittneri* Philip, 1969 nom. nov. and *O. pulchellus* (Bittner, 1892). This indicates that at the end of the 19th century the concept of the genus *Coptechinus* Cotteau, 1883, was quite different from the original description and from the current interpretation. In that period, two new species of *Coptechinus* were instituted from the Eocene of north-eastern Italy: *Coptechinus italus* Oppenheim, 1902, based on a single specimen from Forte S. Felice near Verona (Veneto Region), and *Coptechinus bittneri* Dainelli, 1915, represented by two specimens from Buttrio (Friuli region). *C. italus* and *C. bittneri* were subsequently cited by FABIANI (1915), respectively from the Priabonian of Veneto and the “Auversian” (actually Bartonian, middle Eocene) of Friuli.

## Results and Discussion

## Systematics

Order Camarodonta Jackson, 1912

Infraorder Temnopleuridea Kroh & Smith, 2010

Family Trigonocidaridae Mortensen, 1903

Genus *Scolecchinus* Lambert in Lambert & Thiéry, 1925

Type species: *Scolecchinus dallonii* Lambert in Lambert & Thiéry, 1925, p. 570, by original designation.

Species included:

*S. dallonii* (Lambert, 1925); upper Oligocene, Algeria.

*S. sossanensis* n. sp.; upper Eocene, Italy (this paper).

**Diagnosis** (partially modified from SMITH & KROH, 2011): Small-sized test with low domal profile. Apical disc dicyclic; all plates with epistromal ornament. Ambulacral plating trigeminate. Pore-pairs arranged in near vertical arcs forming a single adradial line. One primary tubercle to each compound plate. Interambulacral plates with a small central primary tubercle. Smaller secondary tubercles on either side below the ambitus. Primary tubercles imperforate and linked by vertical ridges in each column. All plates ornamented by a rather coarse radial epistroma. Peristome with feeble buccal notches.

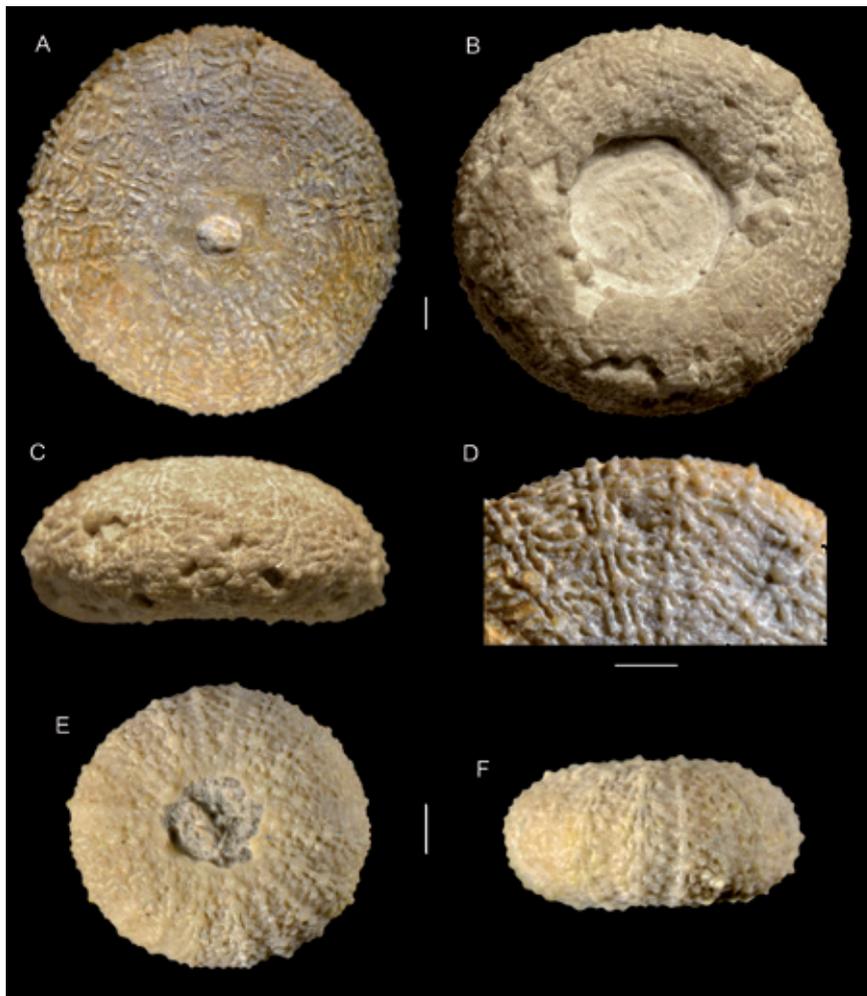


Fig. 3 - *Scolecchinus sossanensis* n. sp., Priabonian, Sossano. Holotype (MCV.21/173), D= 10 mm: A) aboral view; B) oral view; C) lateral view; D) detail of the aboral face. Paratype (MCV.21/174), D= 6.4 mm: E) aboral view; F) lateral view.

**Remarks:** The test ornamentation is considered as one of the main distinctive characters in the taxonomy of the temnopleuroid echinoids (MORTENSEN, 1943; JEFFERY & EMLET, 2003). It consists of sunken ornaments, made of deep pits or depressions in the test surface, and/or of raised ornament, commonly in form of epistromal ridges.

The specimens from Sossano show well developed epistromal ridges radiating from the primary tubercles and indenting their base (fig. 3D), whereas sharply defined pits resulting in distinct reduction of the plate thickness are missing. This condition distinguishes the family Trigonocidaridae Mortensen, 1903 from the Temnopleuridae A. Agassiz, 1872.

The fossils under study show also the other distinctive characters of the Trigonocidaridae:

- Apical disc dicyclic (fig. 4A).
- Ambulacra trigeminate; the plate compounding is in the echinid-style, with the middle element a demiplate not reaching the perradius, corresponding to the scheme reported in PHILIP (1969, fig. 5d); pore-pairs not expanded adorally.
- Primary tubercles small, similar in size in the ambulacral and interambulacral zones (figs. 3D, 4C).
- Peristome with very feeble buccal notches (fig. 3B).

Within the trigonocidarids, the fossils from Sossano share the following morphological traits with the genus *Scolecchinus*:

- Test small ( $D = 6-10.5$  mm) and low ( $TH = 50-53\%$  D), with rounded ambitus and domal profile (fig. 3C, F). Oral face almost flattened.
- Apical disc with well marked epistromal ornament in all genital and ocular plates; small tubercles and granules are also present, above all along the border of the periproct (fig. 4A). Periproct subcircular, relatively small ( $Dc = 12-13\%$  D).
- Ambulacra rather wide ( $WA = 65\%$   $W1a$ ), with pore-pairs uniserial, arranged in near vertical arcs forming a single adradial line (fig. 4B, D). One primary tubercle to each compound plate, close to the poriferous zone (fig. 4B, D), small secondary tubercles on perradial side, plus scattered small granules.
- Interambulacral plates wider than tall, with a central primary tubercle, secondary tubercles on either side positioned on the epistromal ridges. Primary tubercles in each column linked by vertical ridges.
- Primary tubercles imperforate and weakly crenulate. Although the original diagnosis of *Scolecchinus* stated that the tubercles were not crenulate, in the illustration (SMITH & KROH, 2011) of the holotype of *S. dallonii* the tubercles show distinct, albeit faint, crenulations corresponding to those present in the specimens under study.
- Primary tubercles indented at the base (fig. 4B, D); aborally they are small, but their size increases towards the ambitus and in the oral face: the diameter at the base ranges from 17% to 25% of the plate height. The distance between tubercles in a column decreases adorally (fig. 4B, D).

rally (fig. 4B, D).

- All plates are strongly ornamented by raised ornament consisting of rather coarse radial epistroma radiating from the base of all primary tubercles. The basic pattern is made of three parallel ridges (one or two in the ambulacra) linking vertically the primary tubercles (fig. 3D).
- Secondary tubercles and granules are scattered on the ridges.

Among the family Trigonocidaridae the specimens under study are apparently close to species of the genus *Ortholophus* Duncan, 1887. Together with *Coptechinus*, from the Tertiary of Europe, *Ortholophus* has long been considered a synonym of *Paradoxechinus*. However, *Coptechinus* differs in possessing smooth tubercles and has secondary ornament of granules rather than tubercles, *Paradoxechinus* is characterized by the sexual dimorphism of the test (PHILIP, 1969). Much of the past uncertainty as to the application of this genus stems also from DUNCAN's original description of the type species (1877), the discrepancies in which were originally pointed out by BITTNER (1892). Duncan described his genus as sculptured by a net-work of "ridge-like costae", but his figure of the type specimen of *O. lineatus* shows no trace of sculpture. The diagnosis of *Ortholophus* was expanded by PHILIP (1969) to cover the different species included in the genus. After PHILIP (1969), distinction at the specific level is difficult in *Ortholophus* since it is mainly based on differences in the test sculpture and no other fundamental characters permit separation of the species. On the other hand, the test sculpture is characterised by a noticeable intra-specific variation: juveniles are often strongly sculptured, ridges being gradually lost in adults with increase in size and number of the secondary tubercles, so giving way to the close secondary granulation of the adults (PHILIP, 1969). Among the known species of *Ortholophus*, the closest similarities in the test sculpture with the specimens from Sossano are with young specimens of *O. bittneri* Philip, 1969 and *O. woodsi* (Laube, 1869), respectively from the upper Eocene and the upper Oligocene - lower Miocene of Southern Australia (PHILIP, 1969, fig. 5 a, b). In *O. lineatus* (Duncan, 1877), *O. venustus* Philip, 1969, and *O. morganensis* Philip, 1969, the sculpture is different, with commonly coalesced ridges forming large bands (compare PHILIP, 1969, fig. 6 g, h). However, the fossils from Sossano differ from all the Australian species by low domal test profile ( $TH < 53\%$  D). In particular, *O. bittneri*, the sole species of *Ortholophus* reported from the Eocene, has more elevate test:  $TH = 60-66\%$  D (PHILIP, 1969, p. 255, fig. 6 e, i, j). Only the variety *O. woodsi fascigar* (Bittner, 1892) has a similar profile; no other species of *Ortholophus* shows this variation in shape of the test (PHILIP, 1969;  $TH = 50-58\%$  D). The fossils from Sossano differs from the Australian species also by the great development of raised ridges in the apical disc, the presence of three ridges vertically linking

the primary tubercles in the interambulacral columns, instead of one or two (PHILIP, 1969, fig. 5 j, fig. 6 i, j). Additionally, the peristome is much larger ( $D_p = 43\text{--}50\%$  D) than in similar-sized specimens of *O. woodsi*, *O. bittneri*, *O. morganensis* and *O. venustus* (range of  $D_p = 33\text{--}38\%$  D).

- *Brochopleurus* Fourtau, 1920, another trigonocidarid from the Miocene of the Mediterranean area, was considered by MORTENSEN (1943) as possible junior synonymous of *Scolecchinus*. On the other hand, *Brochopleurus* is currently considered by SMITH & KROH (2011) and KROH & MOOI (2022) as junior synonym of *Ortholophus*. However, in *Temnechinus stellatus* Duncan & Sladen, 1886, the type species of *Brochopleurus*, the tubercles are stated to be smooth, not crenulate, thus differing from both *Scolecchinus* and *Ortholophus*. *Scolecchinus* is here maintained separate from *Brochopleurus* also for the strong raised ornamentation present in all the plates of the apical disc.

- *Trigonocidarid* Agassiz, 1869, today living in the Atlantic Ocean, has similar test shape, size and ornamentation, but the apical disc is highly characteristic, in having smooth genital plates with a single small tubercle (MORTENSEN, 1943). Additionally, no fossil records are known of this genus.

A number of other temnopleuroid echinoids with apparently similar sculptured test are known from the Eocene to the Miocene: *Paradoxechinus* Laube, 1869, *Dictyopleurus* Duncan & Sladen, 1882, *Arachniopleurus* Duncan & Sladen, 1882. The first two genera belong to a different family, the Temnopleuridae, due to the presence of sunken sculpture (KROH & MOOI, 2022). *Arachniopleu-*

*rus* belongs to the Glyphocyphidae Duncan, 1889, based on its poligeminate ambulacral plates.

- *Paradoxechinus*, upper Eocene to lower Miocene of Australia, differs from the specimens under study also by its marked sexual dimorphism: the apical disc is large and deeply sunken in females, forming a marsupium with a central knob made of the inner parts of the genital plates rising above the level of test so as to be clearly visible in lateral view (PHILIP & FOSTER, 1971, fig. 1). The sunken zone of coronal plates bears only a fine and dense tuberculation. Additionally there is a marked sculpture in the form of horizontal deep pits in the perradial zone of the ambulacra.

- *Dictyopleurus*, upper Palaeocene to lower Eocene of Pakistan, is distinguished also by the apical disc, which is hemicyclic, and by its perforate primary tubercles.

- *Arachniopleurus*., upper Paleocene to Eocene of Pakistan and Europe, differs also by its perforate primary tubercles and the test ornamentation consisting of sub-circular raised ridges surrounding the primary tubercles.

Also the two species of *Coptechinus* earlier described from the Eocene of north-eastern Italy, *C. italus* Oppenheim, 1902 and *C. bittneri* Dainelli, 1915, are apparently similar to the specimens under study. However, in *Coptechinus* from the type-area (Miocene of north-western France) the ornament consists of large wedge-shaped deep pits plus narrower pits on the adradial side of the primary tubercles along the sutures. For this reason *Coptechinus* is currently assigned (SMITH & KROH, 2011; KROH & MOOI, 2021) to the family Temnopleuridae. Additionally, in *Coptechinus* the test is flattened above and the apical disc shows a strong sexual dimorphism, sin-

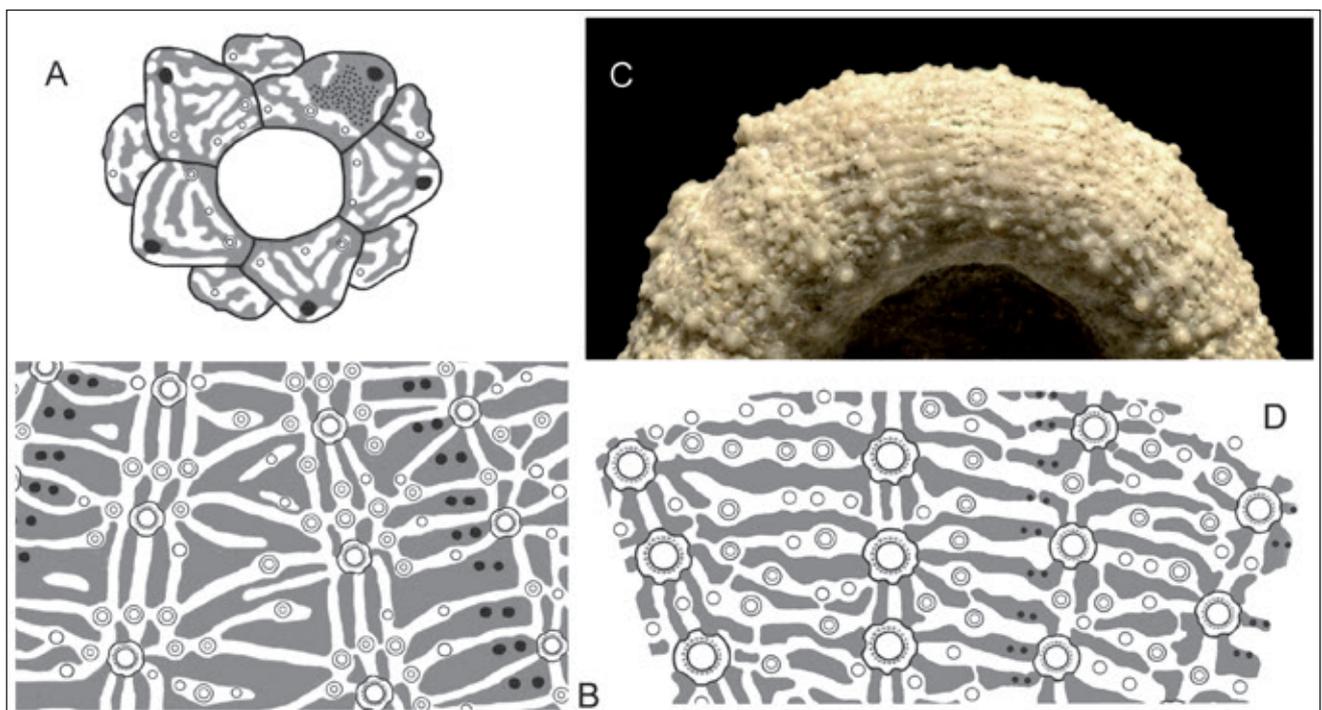


Fig. 4 - *Scholecchinus sossanensis* n. sp., Priabonian, Sossano. A-B) holotype (MCV.21/173), D= 10 mm, respectively scheme of the apical disc (A) and of supra-ambital plates (B). C-D) paratype (MCV.21/49), D= 10.5 mm, respectively close up (C) and plating scheme of the oral face (D). In the schemes, white areas represent raised ridges.

ce in females it is large and deeply sunken. OPPENHEIM (1902) affirmed that “*Coptechinus lineatus* Bittner, 1892 is so close to the species from the Eocene of Verona (*C. italus*) that differences are hardly recognizable”. *C. lineatus* has been recently transferred by PHILIP (1969) to the genus *Ortholophus* and renamed *O. bittneri* Philip, 1969, nom. nov. The same case occurred for *C. pulchellus* Bittner, 1892, thus indicating that the interpretation of *Coptechinus* by those ancient scholars was quite different from the original description by COTTEAU (1883) and that the attribution to *Coptechinus* of the two species from the Eocene of Veneto by OPPENHEIM and DAINELLI is not correct.

In the fossils from Sossano the ornamentation is more complex than in *C. italus* and *C. bittneri*. *C. italus* differs also by the depressed peristome and “pores disposed in two diffused series” (OPPENHEIM, 1902), although this detail is not visible in the original illustration. The specimens from Buttrio are much larger ( $D = 13$  and  $28$  mm), the ambulacra are narrower in proportion ( $WA = 50\%$   $WIa$  at the ambitus) and the epistromal ridges are smooth. On the basis of the characteristic geometrical ornamentation made of narrow smooth ridges, *C. bittneri* resembles more *Dictyopleurus*; however DAINELLI described imperforate and non-crenulate tubercles in his specimens. OPPENHEIM (1902) and DAINELLI (1912) affirmed that some morphological details were not visible in the type specimens. Unfortunately, it is not possible to ascertain if the absence of perforation and crenulation in *C. italus* and *C. bittneri* was due to the preservation of the types since their whereabouts are unknown. The generic placement of these two species remains uncertain.

***Scolecchinus sossanensis* n. sp.**

Figs. 3-4, Tab. 1

Type material: holotype (MCV 21/173) and two paratypes (MCV 21/49, 21/174)

Type locality: Sossano (Vicenza Province, Italy).

Type stratum: Priabonian (upper Eocene).

Origin of name: from Sossano, the finding locality.

**Diagnosis:** a species of *Scolecchinus* with large peristome ( $Dp$  up to  $50\%$   $D$ ), ridges radiating from the base of primary tubercles and connecting on either side the adjacent tubercles.

**Remarks:** The specimens from Sossano differ from *Scolecchinus dallonii* Lambert in Lambert & Thiéry, 1925, upper Oligocene of Algeria, the type species of this genus, by:

- The test may be also flattened above (fig. 3F).
- Apical disc smaller:  $Ap = 33\%$   $D$ , against  $40\%$   $D$ .
- The raised ridges starting from the base of the primary tubercles connect also the adjacent ambulacral tubercles on either sides (fig. 4B, D). In *S. dallonii*, the ridges are denser, leaving almost no naked spaces, and do not connect laterally the other tubercles.
- The peristome is much larger (mean  $Dp = 46\%$   $D$ , against  $37\%$   $D$ ) and the area around the peristome is rather depressed, whereas in *S. dallonii* it is more or less flush.

Since no other species of *Scolecchinus* are known, the fossils from Sossano are assigned to a new species: *Scolecchinus sossanensis* n. sp.

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	D	H		Da		Dp		WA/WIa	nA	nIA
		mm	%D	mm	%D	mm	%D			
Holotype MCV.21/173	10	5.3	53	3.3	33	4.5	45	66	11-12	11-12
Paratype MCV.21/49	10.5	-	-	3.4	32	4.5	43	64	12-13	12-13
Paratype MCV.21/174	6.4	3.2	50	2.5	39	3.2	50	65	9-10	9-10

Table 1 - *Scolecchinus sossanensis* n. sp.: main biometric data of the type-specimens.

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