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## INDICE - CONTENTS

D. MAURO, C. BIAGIONI, M. PASERO, F. ZACCARINI, <i>Crystal-chemistry of sulfates from Apuan Alps (Tuscany, Italy). II. Crystal structure and hydrogen bonding system of r��merite, <math>Fe^{2+}Fe^{3+}_2(SO_4)_4(H_2O)_{14}</math>.</i> Cristallochimica dei solfati delle Alpi Apuane (Toscana, Italia). II. Struttura e legami a idrogeno della r��merite, $Fe^{2+}Fe^{3+}_2(SO_4)_4(H_2O)_{14}$ .	pag. 5
E.J. ANTHONY, <i>Sand and gravel supply from rivers to coasts: A review from a Mediterranean perspective.</i> L'apporto di sabbia e ghiaia dai fiumi alle coste: una review dal punto di vista del Mediterraneo.	» 13
L. JASELLI, A. COLLARETA, <i>Redescription and first illustration of the holotype of Astropecten montalionis (Meneghini, 1852) [Paxillosida: Astropectinidae].</i> Ridescrizione e prima illustrazione dell'olotipo di <i>Astropecten montalionis</i> (Meneghini, 1852) [Paxillosida: Astropectinidae].	» 35
F. RAPETTI, <i>L'alluvione di Livorno del 10 settembre 2017 (Toscana, Italia).</i> Leghorn flood on September 10 2017 (Tuscany, Italy).	» 45
D. BERTONI, M. MENCARONI, <i>Four different coastal settings within the Northern Tuscany littoral cell: how did we get here?</i> Quattro diversi ambienti costieri all'interno della cella litoranea della Toscana settentrionale: come siamo arrivati a questo punto?	» 55
D. PIERUCCIONI, S. VEZZONI, M. PETRELLI, <i>A petrographic and U-Pb geochronological approach to the reconstruction of the pre-Alpine history of Alpi Apuane (Tuscany).</i> Un approccio petrografico e geocronologico U-Pb per la ricostruzione della storia pre-Alpina delle Alpi Apuane (Toscana).	» 69
A. GATTI, P. MARIANELLI, D. ANDRONICO, A. SBRANA, <i>The December 2015 paroxysms at Mt. Etna: insights from mineral chemistry and glasses.</i> L'eruzione parossistica dell'Etna del dicembre 2015: indicazioni sul comportamento del sistema di alimentazione dallo studio di minerali e vetri.	» 81
P. R. FEDERICI, S. MERLINO, R. GRIFONI, <i>In memoria di Aldo Giacomo Segre (1918-2018).</i> In Memoriam Aldo Giacomo Segre (1918-2018).	» 93
Processi Verbali - <a href="http://www.stsn.it">http://www.stsn.it</a> .	» 101



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## REDESCRIPTION AND FIRST ILLUSTRATION OF THE HOLOTYPE OF *ASTROPECTEN MONTALIONIS* (MENECHINI, 1852) [PAXILLOSIDA: ASTROPECTINIDAE]

**Abstract** - L. JASELLI, A. COLLARETA, *Redescription and first illustration of the holotype of Astropecten montalionis (Meneghini, 1852) [Paxillosida: Astropectinidae]*.

*Astropecten montalionis* (Echinodermata: Asteroidea: Astropectinidae) was first described by Giuseppe Meneghini in 1852 (as *Crenaster montalionis*), the description following the donation by the municipality of Montaione (Tuscany, Central Italy) of a sandstone slab with an embedded fossil starfish specimen to the Museo di Storia Naturale dell'Università di Pisa. This slab was previously embedded in the floor of the main square of Montaione, in front of the church of S. Regolo, and for a long time it was eroded and damaged by pedestrian passage. Unfortunately, the specimen has never been figured in the literature. This fossil is here redescribed, taxonomically re-evaluated, and figured.

**Key words** - Asteroidea (Echinodermata), Paxillosida, Astropectinidae, Taxonomy, Pliocene, Meneghini, Italy.

**Riassunto** - L. JASELLI, A. COLLARETA, *Ridescrizione e prima illustrazione dell'olotipo di Astropecten montalionis (Meneghini, 1852) [Paxillosida: Astropectinidae]*.

*Astropecten montalionis* venne descritta per la prima volta da Giuseppe Meneghini nel 1852 (come *Crenaster montalionis*), quando la municipalità di Montaione (Firenze, Toscana) donò al Museo di Storia Naturale dell'Università di Pisa una lastra di arenaria inglobante i resti di una stella marina fossile. Questa lastra era posizionata nella piazza principale di Montaione, di fronte alla chiesa di S. Regolo, e per molto tempo fu soggetta a calpestio e ad una lenta erosione. Nonostante il suo status di olotipo, questo esemplare non venne mai figurato, ragion per cui *Astropecten montalionis* venne talvolta indicata in letteratura come *species dubia*. Il reperto viene qui ridescritto, rivalutato da un punto di vista tassonomico e infine illustrato.

**Parole chiave** - Asteroidea (Echinodermata), Paxillosida, Astropectinidae, Tassonomia, Pliocene, Meneghini, Italia.

### INTRODUCTION

Asteroids (Echinodermata: Asteroidea), also known as “starfish” or “sea stars”, are a highly diversified class of echinoderms represented by more than 1.900 extant species grouped in 36 families and approximately 370 genera (Mah & Blake, 2012). These benthic organisms are present in all the oceans of the world and occur at all depths, from intertidal to abyssal (i.e., beyond 6000 m) environments. Asteroids live in a wide range of habitats and exhibit significant inter and intraspe-

cific differences in terms of feeding habits, including predators, scavengers, and substrate film-feeders (Janoux, 1982).

Sea stars are characterized by a dorsoventrally flattened body consisting of 5 to 50 arms projecting from a central disk. Their skeleton consists of a large number of unfused ossicles which allow body flexibility.

All extant asteroids belong to the crown group Neoasteroidea, whose earliest occurrence as fossils dates back to the late Triassic. The earliest neoasteroids were described by Zardini (1973) from the Carnian beds of the St. Cassian Formation (Dolomites, Eastern Alps, Northeastern Italy). No Paleozoic family crossed the Permo-Triassic boundary, and a large fraction of the extant asteroid families (i.e., roughly one-third to one-half) are known since the Jurassic (Gale, 1987).

The Astropectinidae is one of the larger families of extant Asteroidea, with 26 genera and 243 species described, the genus *Astropecten* including more than two fifths of the total number of species in this family (Mah & Blake, 2012).

Taxonomy of *Astropecten*, based on morphological characters of living individuals, was assessed by Döderlein (1917). Döderlein's effort was later reappraised by Zulliger & Lessios (2010) who used molecular phylogenetic approaches to resolve general taxonomic issues. Genetic data highlighted a few cases of synonymy but also suggested that, despite the abundance of species in the genus *Astropecten*, many new species have still to be described, increasing even more the alpha-diversity within this genus.

Most astropectinids occur in cold waters (based on sea-surface temperatures ranging between 0 and 5°C), with a minority of species inhabiting tropical and/or subtropical-temperate environments. They both exhibit a cosmopolitan distribution and primarily live in shallow water on sandy or coarser unconsolidated substrates which prove appropriate for a mainly burial life mode. These organisms exhibit detritivorous or predatory feeding strategies and the latter are able to ingest large preys (molluscs, echinoderms and even other astropectinids; Fernández et al., 2014), thanks

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to the highly extensible muscular dorsal integument (Gale, 1987). In spite of their overall cold water affinities, various species of *Astropecten* currently inhabit the Mediterranean area, namely: *Astropecten aranciaceus* (Linnaeus, 1758); *A. jonstoni* (Delle Chiaje, 1827); *A. irregularis* (Pennant, 1777); *A. spinulosus* (Philippi, 1837); *A. bispinosus* (Otto, 1823), and *A. platyacanthus* Philippi, 1837 (Koehler, 1921; Tortonese, 1965).

These extant forms, living in the Mediterranean Sea, share several morphological characters with some fossil individuals referred to the same genus. Since the mid-19th Century as already described by several authors (Savi & Meneghini, 1851; Meneghini, 1852; Cavara, 1862; Sacco, 1893, Del Prato, 1896), the Pliocene marine sediment exposed in Central and Northern Italy (Tuscany, Emilia-Romagna, and Piedmont regions) have yielded several complete astropectinid specimens as well as loose ossicles.

Von Linstow (1909) listed all Italian fossil occurrences of astropectinids known to that date. This work can also be useful to outline the timing of discoveries of fossil sea stars in this country. The earliest of these finds, *Crenaster montalionis* Meneghini 1852, came from Montaione (Tuscany). Later, Meneghini (1862) also described a new astropectinid species from the Piacenzian "Argille Turchine" (=Argille Azzurre *Auctt.*) Formation of Tuscany as *Astropecten Soldanii* Meneghini, 1862, *A. ornatus* Meneghini, 1862, and *A. foveolatus* Meneghini, 1862. Cavara (1866) and Sacco (1893) illustrated some astropectinids from the Piacenzian outcrops of the Piedmont (Northern Italy): *A. bononiensis* Cavara, 1866, *A. cf. bispinosus* Otto, 1823, and *Astropecten* sp. Del Prato (1896) described finds from the "Tertiary" terrains of Emilia Romagna (Central Italy) as belonging to the new species *Astropecten linati* Del Prato, 1896. This author also described *Astropecten* sp. from the Province of Parma; this specimen was later reattributed by Borghi & Bajo Campos (2008) to *Astropecten* cf. *forbesi* Heller, 1858. After a gap of more than a century, Repetto & Bicchi (2013) described *Astropecten* cf. *irregularis pentacanthus* Delle Chiaje, 1825 from the muddy clay outcrops of Cherasco (Piedmont). Moreover, it should be pointed out that various of these species were established only on the basis of incomplete or badly preserved specimens, and in some case just based on rare, loose marginalia. Moreover, inadequate morphological descriptions and lack of illustrations can also increase the risk of artificially multiplying the number of species. The latter was also the case of *Crenaster montalionis*, which was established by Meneghini in 1852 on the basis of a very concise description, devoid of any illustration. Furthermore, 35 years later, Meneghini provided a new, more detailed morphological description of the holotype, which he transferred into the genus *Astropecten*, still without including any figure (Meneghini,

1887). This inhibited subsequent authors from studying in depth this fossil specimen, as testified by Hess (1955) who referred to *Crenaster montalionis* as *species dubia*.

The present work: (1) provides redescription of *Astropecten montalionis*, (2) reevaluates its taxonomic assessment, and (3) integrates geological and paleoenvironmental data with information about the historical context of specimen discovery and its subsequent history. Not least, the present work provides the first illustration of the holotype, 166 years after its original description by Meneghini (1852).

The illustration of *Astropecten montalionis* will provide new insights on this astropectinid species, as well as reference for studies to come.

#### HISTORICAL CONTEXT OF THE FOSSIL DISCOVERY

The municipality of Montaione (Fig. 1) is located about 50 km southwest of Florence (Tuscany, Central Italy), 342 meters above sea level, among smooth hills of vineyards and olive groves. This village is documented since the 13<sup>th</sup> Century (Repetti, 1833) and presumably it was founded with the church of San Regolo (Fig. 2) located in the main square of the village (Angelelli, 1875).



Fig. 1 - Geographic location of the locality discussed in the present work. The star indicates the village of Montaione, Florence Province, Italy.





Fig. 2 - The façade of the church of San Regolo in Montaione as it can be observed today. Until the mid-XIX Century the sea star specimen here re-described was embedded in the pavement of the church square.

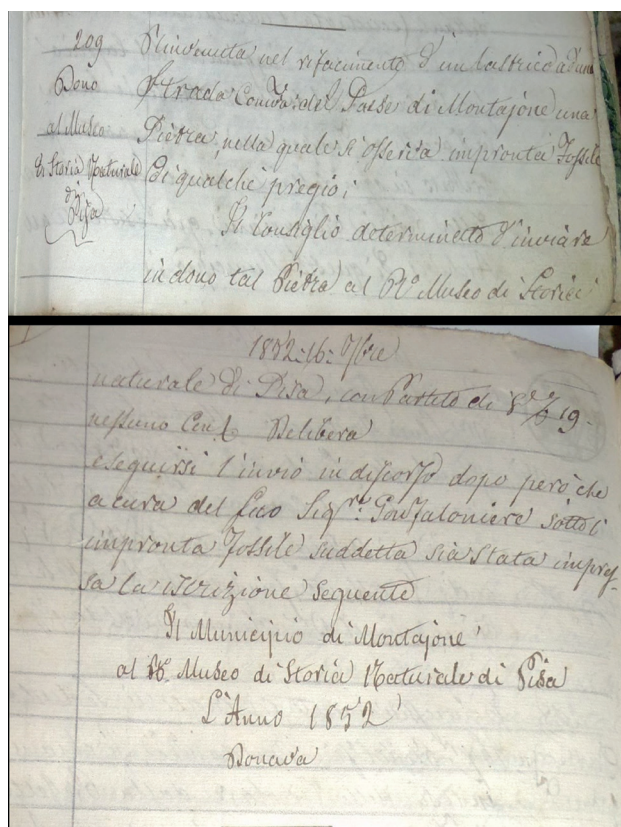


Fig. 3 - Resolution n. 209 of the Municipality of Montaione, raised on September 16<sup>th</sup>, 1852. It states the approval of the donation of a fossil-bearing rock slab recovered to the Museo di Storia Naturale di Pisa (Montaione historical archive, photo credit: Rino Salvestrini).

In 1852, during some maintenance work to the pavement of the church square, a remarkable sandstone slab was removed. It contains articulated remains of a starfish. (Meneghini [1852] pointed out that at that time sandstone slabs from a quarry located not far from Montaione were commonly used to pave the streets of the village). This fossil specimen appeared as eroded and damaged by pedestrian passage, but still clearly visible. Later, the municipality of Montaione presented the fossil-bearing slab to the Museo di Geologia e Paleontologia dell'Università di Pisa with resolution no. 209, dated September 16<sup>th</sup> 1852 (Fig. 3).

Giuseppe Meneghini, during the mid-19th Century, used to visit the zone of Montaione, as he took care of several mining areas, such as the copper mine located in S. Biagio or the cinnabar mine located in Jano (see electronic appendix). He welcomed the fossil donation and promptly described the specimen on his work *Nuovi fossili toscani illustrati* (Meneghini, 1852)

recognizing the fossil sea star as the sole representative of the new extinct species *Crenaster montalionis* (Meneghini, 1852).

Unfortunately, further information concerning when, why and who put this slab in front of the church are still unknown. It is likely that the fossil-bearing slab had been placed in the church square as a voluntary action and not by a chance. It could be a sign of devotion of the laborers who were working on the church square maintenance, or even a specific request by a commissioner.

The holotype of *Astropecten montalionis* has been part of the paleontological collection of the University of Pisa since its donation by the city of Montaione to the former "Museo di Geologia" then merged, together with most of the museums of this university, in the present-day "Museo di Storia Naturale". Together with the rest of the paleontological collection, *Astropecten montalionis* was later moved to the present venue of the museum at the "Certosa di Pisa", in the village of Calci. This move occurred during the eighties of the twentieth century and the original label of *Astropecten mon-*

*talionis* was probably lost during this transfer. However, the lack of its tag did not prevent its exhibition to the public (since 2000 to 2017, the specimen was exposed as an example of nicely preserved fossil starfish at the Dipartimento di Scienze della Terra dell'Università di Pisa). Nowadays, after having been recognized as the holotype of *Astropecten montalionis*, the specimen is exhibited at the "Museo di Storia Naturale" in the historical section dedicated to Giuseppe Meneghini. A summary on the scientific activity and career of Giuseppe Meneghini is attached as an electronic appendix to the present paper.

#### GEOLOGICAL AND PALAEONTOLOGICAL SETTING

The starfish specimen described herein is embedded in a yellowish arenaceous slab whose aspect compares favorably with that of the sandstone beds that are exposed in the surroundings of Montaione (Meneghini, 1852, 1887). All the transgressive sandy outcrops lying at the base of the Pliocene strata are currently referred to the Sabbie di San Vivaldo Formation (Costantini et al., 2002).

The Sabbie di San Vivaldo Formation (=Sabbie di Gambassi of Dominici et al., 1995) is comprised of medium- to coarse-grained pebbly sands. Its thickness reaches 100 meters in the surroundings of Mura (c. 3 km northwest of Montaione) while outcrops less than 10 meters in thickness occur in other areas. The top of this formation corresponds to the base of the overlying Argille Azzurre Formation.

The fossiliferous content of the Sabbie di San Vivaldo is rather abundant throughout its thickness and characterized by a high number of ostreid specimens, evocative of a coastal paleoenvironment. In the higher part of this unit, remains of molluscs, crustaceans, echinoids and corals are quite common as well (Dominici et al., 1995).

Fossil remains of continental plants and mammals, such as some teeth of *Rhinoceros* and a *Mastodon* tusk, have also collected from these sediments (Dominici et al., 1995). These findings suggest that, during the Zanclean, the Montaione area was characterized by a coastal paleoenvironment somewhat close to a river mouth (Gaudin & Strozzi, 1858; Dominici et al., 1995). Besides the holotype of *Astropecten montalionis*, other remarkable Pliocene specimens of marine organisms from the surroundings of Montaione include the holotype of the balaenid mysticete *Balaena montalionis* Capellini, 1904 from an exposure of the Sabbie di San Vivaldo at the locality known as "Casina" (Trevisan, 1941) and two rostral spines of the knifetooth sawfish *Anoxypristis* cf. *cuspidata* from an exposure of the Argille Azzurre Formation at the locality known as "Tegoliccio" (Collareta et al., 2017).

#### MATERIAL AND METHODS

The following institutional abbreviations are used: IPUW, Institut für Paläontologie, Universität Wien; MSNUP, Museo di Storia Naturale dell'Università di Pisa; MSNVI, Museo di Storia Naturale "Antonio Stoppani" Venegono Inferiore (VA).

The fossil specimen studied and illustrated herein is currently housed in the palaeontological collection of the Museo di Storia Naturale dell'Università di Pisa (MSNUP) under accession number MSNUP I-17605. This specimen consists of a c. 28 × 32 cm slab of yellowish sandstone embedding an asteroid specimen. Significant for the aim of the present study was also the comparison with specimen IPUW 1858-1-1 holotype of *Astropecten forbesi* Heller, 1858 housed at the Institut für Paläontologie of the Vienna University, and one specimen of the extant red comb star *Astropecten aranciaceus* MSNVI 010/023 housed at the Museo di Storia Naturale "Antonio Stoppani" Venegono Inferiore (VA). MSNUP I-17605 was analyzed and photographed under a Dino-Lite Digital Microscope AM4113TL-M40. The anatomical terminology applied in the present work mostly follows Blake (1987, 1989).

#### SYSTEMATIC PALAEONTOLOGY

Asteroidea de Blainville, 1830  
Neoasteroidea Gale, 1987  
Paxillosida Perrier, 1884  
Astropectinidae Gray, 1840

*Astropecten* Gray, 1840  
*Astropecten montalionis* (Meneghini, 1852)  
(Figs. 4-6)

1852 *Crenaster montalionis* Meneghini, p. 40  
1862 *Crenaster montalionis* Meneghini, p. 8  
1887 *Astropecten montalionis* Meneghini, p. 5  
1893 *Astropecten montalionis* Sacco, p. 745  
1909 *Astropecten montalionis* von Linstow, p. 54  
1955 *Astropecten montalionis* Hess, p. 72

**Material** - MSNUP I-17605, a partially complete and articulated asteroid specimen, disposed dorsal side-up, preserved within a sandstone slab.

**Taxonomic remarks** - Meneghini (1852) referred the asteroid specimen MSNUP I-17605 to the genus *Crenaster* d'Orbigny, 1850. *Crenaster* was then recognized as a junior synonym of *Astropecten* Gray, 1840. That was acknowledged by Meneghini (1887), who recombined *Crenaster montalionis* as *Astropecten montalionis*.

**Description** - Large-sized sea star, disk small with respect to the elongate arms, 55 mm in diameter,





Fig. 4 - MSNUP I-17605, the holotype and only known specimen of *Astropecten montalionis* (Meneghini 1852), from the Zanclean (Pliocene) of Montaione, Italy. Scale bar corresponds to 20 mm.



Fig. 5 - MSNUP I-17605, the holotype and only known specimen of *Astropecten montalionis* (Meneghini 1852), from the Zanclean (Pliocene) of Montaione, Italy. Close-up of the disc area and madreporite. Scale bar corresponds to 10 mm.

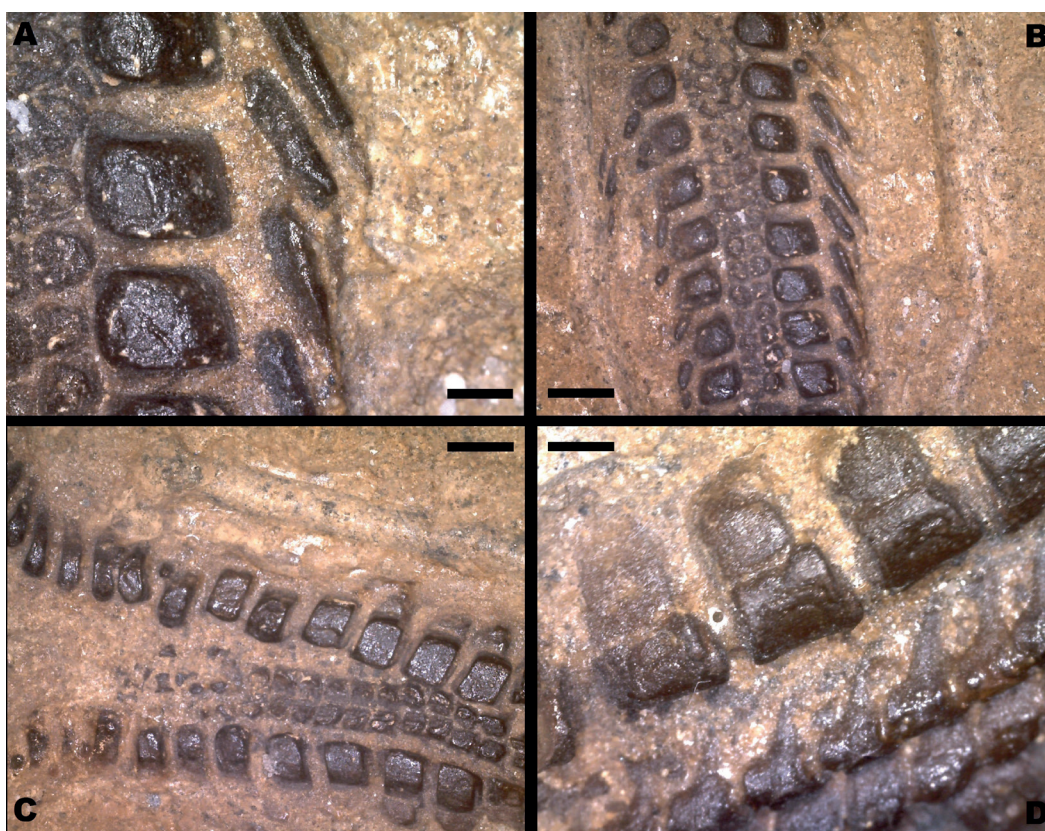


Fig. 6 - *Astropecten montalionis* Meneghini 1852, MSNUP I-17605, from the Zanclean (Pliocene) of Montaione, Italy. (A) Inferomarginal fringe spines strong and divergent, flattened and longer than the corresponding plates. Scale bar corresponds to 3 mm. (B) Superomarginals contiguous but not closely abutted throughout their full height, spaced of about 2-4 mm. Scale bar corresponds to 11 mm. (C) Abactinal skeleton of arms with two longitudinal rows of aligned and paired ossicles. Scale bar corresponds to 11 mm. (D) Adambulacrials narrow, with robust and erect spines. Scale bar corresponds to 3 mm.



interbrachial angles tightly rounded (Fig. 4). Five arms (three of which are completely preserved), narrow and elongate, triangular, broad at the base, tapering distally, and having rounded extremities.

Radius of the longest arm measures 148 mm ( $R/r = 148:55 \text{ mm} = 2.7/1$ ), other radii measuring 135 mm, 113 mm, 92 mm, and 80 mm respectively. Oval madreporite (about 10 mm in diameter), located marginally in one of the abactinal interbrachial areas (Fig. 5). Abactinal surface of the disk partially covered by paxilliform ossicles, roughly rounded in outline, similar in size, and arranged in an even pattern.

Marginals organized in two rows, rather large, approximately squared in outline, slightly rhomboidal, each approximately 3 mm long; ossicles from the two rows appear as paired and aligned. Superomarginals contiguous but not tightened, spaced of about 2–4 mm. The intermarginal ridges for the marginal fascioles could have been large enough to have produced gaps in *A. montalionis*. Inferomarginal plates overlaid and hidden by superomarginals. Marginals in the interbrachial angles are triangular in outline and smaller than those of the arms.

Radii provided with 36–40 superomarginal plates ( $SM = 36\text{--}40$ ,  $R/SM = 3.9$ ), apparently devoid of spines. Inferomarginal fringe spines strong and divergent, flattened, and longer than the corresponding plates. Abactinal skeleton of the arms consisting of two longitudinal rows of aligned and paired ossicles; ambulacra rather squared, smaller than (but similar in outline to) the marginals, distally longer than wide; adambulacra narrow, with robust erect spines (Fig. 6).

#### COMPARISONS WITH EXTANT ASTROPECTINIDAE

Comparisons between *Astropecten montalionis* and previously described astropectinid forms suggest that the former can be considered a distinct species due to its different skeletal anatomy. Moreover, *A. montalionis* can also be distinguished from the most representative extant astropectinid forms of the Mediterranean Sea. For example, *A. irregularis pentacanthus* has a different body outline, characterized by a large disc and small arms. The same can also be said for *A. jonstoni*, which represents the smallest Mediterranean species, with a maximum diameter of 70–80 mm (Pillon, 2009). *Astropecten spinulosus* is also a small starfish species that features slender arms with rounded tips. *Astropecten bispinosus* and *A. platyacanthus* are provided with long, sharp superomarginal spines that in the latter species are small, irregularly shaped, and laterally flattened. In turn, *A. montalionis* shares many characters with *A. aranciaceus*, including: (1)  $R/SM$  ratio greater than 2 (3.9 in the studied sample), (2) the overall body outline, (3) the

presence of narrow and long arms, (4) tumid superomarginal plates, more or less limited to the abactinal surface, (5) one inferomarginal spines forming ambital fringe, (6) inferomarginal fringe spine shape is flat, normal position of inferomarginal fringe spines erect, arrangement of inferomarginal fringe spines horizontal, (6) adambulacral furrow spine shape acute, and, above all, (7) the great body size (*A. aranciaceus* is the largest astropectinid of the Mediterranean Sea, being able to grow up to 550 mm in diameter). With a diameter around 250 mm, *A. montalionis* represents the largest fossil form of Astropectinidae described until now from the Mediterranean region. Unfortunately, no other characters are observable on MSNUP I-17605, except for the expression of the madreporite, which is the same as in *A. aranciaceus*.

#### COMPARISONS WITH OTHER ITALIAN FOSSIL ASTROPECTINIDAE

Reports of fossil sea stars in Italy are rather rare. Von Listow (1909) provided a then-complete list of the Italian Neogene asteroids referenced in literature. Among them, the earliest described one is the specimen here reappraised (Meneghini, 1852). As already pointed out, this original description was rather concise and devoid of any figure or illustration. Meneghini (1852) mentioned that the starfish specimen was heavily eroded, oriented dorsal side-up, and had long arms tapering distally as the extant *Crenaster aranciaceus* (= *Astropecten aranciaceus*).

Ten years later, Meneghini (1862) reported more or less the same description without providing any illustrations. He also described three new astropectinid species from the Piacenzian beds of Tuscany: *Astropecten soldanii*, *A. foveolatus* and *A. ornatus*. He also argued that ossicles of *Crenaster montalionis* are very different in shape and size from those of the aforementioned taxa, thus supporting a species-level separation.

Several years later, Meneghini (1887) recombined *Crenaster montalionis* as *Astropecten montalionis*, eventually providing a new detailed description of the holotype, unfortunately not accompanied by illustrations or figures. Almost apologizing with the reader, he put a very long note stating that *to the imperfect description I gave in the two previous opportunities, I have to add the following observation*" (Meneghini, 1887, translated from the Italian by the authors of the present paper). Meneghini (1887) also stated that ambulacra are very similar to the ones described by Heller (1858) for *Astropecten forbesi* from the upper Badenian beds of Austria and that these two species are very similar despite the different number of marginal plates. Regarding this last assumption, it appears that Meneghini misunderstood the description provided

by Heller (1858), who stated that *A. forbesi* showed 70–80 marginal plates per arm and not for each side of the arm.

Observing the holotype of *Astropecten forbesi*, we could easily count around 30 plates on each side, thus strongly recalling *A. montalionis* in this aspect. By comparing the holotypes of *A. montalionis* and *A. forbesi*, the abactinal ossicles of the latter do not appear so uniform in shape and arrangement as observed in *A. montalionis*. Moreover, the inferomarginal spines of *A. montalionis* are clearly shorter and divergent, whereas the marginals are different in shape and not contiguous. Finally, measurements of *A. forbesi* are more or less half of those of *A. montalionis*. Therefore, in the light all these differences, *A. montalionis* and *A. forbesi* should be considered as separate species. Nonetheless, it should be noted that Borghi & Bajo Campos (2008) have redescribed an *Astropecten* specimen from the Langhian beds of Gombio (Reggio Emilia province) as belonging to *A. cf. forbesi*, thus possibly providing the first record of Heller's species in Italian deposits.

After the works by Meneghini, Cavara (1886) reported on a new fossil astropectinid specimen collected from the Pliocene beds of Gavignano (Bologna province). This resemble *A. bispinosus* but it is devoid of spines. Cavara asked Meneghini for support on the identification of this specimen (Cavara, 1886). Meneghini stated that it was a new form, different from every other neogenic sea star already described, and thus Cavara erected the species *Astropecten bononiensis*.

Later, *A. cf. bispinosus* was described by Sacco (1893) from the middle Piacenzian of Bra (Piedmont). Sacco (1893) complained that five astropectinid species from the Pliocene of Italy had already been described (by Meneghini) but most of them were never figured, thus preventing any further comparison. Avoiding to establish further new species, Sacco (1893) regarded the studied specimen as close to the extant *A. bispinosus* without providing a more precise identification. Besides *Astropecten* sp., later identified by Borghi & Bajo Campos (2008) as *Astropecten cf. forbesi*, Del Prato (1896) also described another astropectinid collected from Pliocene beds near Parma. This specimen resembled *A. foveolatus* but, due to its long supero- and infero-marginal spines (even longer than in *A. bispinosus*), it was elected as the holotype of the new species *Astropecten linati*. The lack of long superomarginal spines in *A. montalionis* indicates that *A. cf. bispinosus* and *A. linati* are in fact distinct species.

A revision of the systematics and taxonomy of Astropectinidae was provided by Hess (1955). In this work, the author regarded as *species dubiae* all the astropectinid taxa established on the basis of incomplete descriptions and/or not figured. *Astropecten*

*montalionis* takes place among them. For this species, wrong measurements ( $R/r = 150:50$  mm) were also reported by Hess (1955). Moreover, Hess (1955) only reported Meneghini's statement that *A. forbesi* is very close to *A. montalionis*, but likely he never saw the holotype of the latter or he would have noticed the marginal plates count mismatch.

#### PALAEOECOLOGY AND TAPHONOMY

Astropectinids live mostly on sandy or muddy seafloors. These carnivorous organisms are particularly active in the night, while during the day they remain buried under the sediment for most of the time. For example, *Astropecten aranciatus* ranges in the Atlantic Ocean and in the Mediterranean Sea (Hansson, 1999); this benthic predator represents the largest sea star species in the Mediterranean and live at depths of 2 to 100 meters (Weinberg, 1992). It feeds on molluscs, and particularly on bivalves (Delongueville & Scaillet, 2004). It ingests the prey and maintains it in the stomach, digesting the tissues and expelling the indigestible parts (e.g., the shell).

The already mentioned resemblance between *A. aranciatus* and *A. montalionis* could suggest that the latter inhabited coastal environments and sandy seafloors (as it was the Montaione area during the Zanclean), both species probably sharing the same feeding ecology and preferences.

From a taphonomic perspective, completeness, articulation, and the overall preservation of the specimen studied herein suggest that this individual was buried while it was in living position. The burial prevented this organism from the rapid decay and the disarticulation of the skeletal parts (Spencer & Wright, 1966).

#### CONCLUSIONS AND PERSPECTIVES

*Astropecten* is a difficult genus because it embraces many nominal species, both extant and extinct, several of which have never been characterized in detail. The re-discovery of the holotype of *Astropecten montalionis* in the collection of the Museo di Paleontologia (University of Pisa) allowed a new description of this specimen which is in line with the original descriptions by Meneghini (1852, 1887). Geological and paleoenvironmental data, as well as information about the historical context of its discovery, have also been provided.

Figured for the first time, this fossil specimens differs from any other the Italian Neogene asteroid. Comparison with extant astropectinid species pointed out strong resemblances with the extant Mediterra-

nean species *Astropecten aranciacus*. Further research, focusing on comparison between MSNUP I-17605 and extant red comb stars, should focus on the possibility that *A. montalionis* is a junior synonym of *A. aranciacus*.

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