Atti Soc. Tosc. Sci. Nat., Mem., Serie A, 121 (2014)
pagg. 47-54, figg. 6; *doi: 10.2424/ASTSN.M 2014.14*

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# THE FIRST OCCURRENCE OF OPHIUROIDS (*OPHIUROIDEA*, *ECHINODERMATA*) IN THE EARLY TRIASSIC OF LOMBARDY (NORTHERN ITALY)

**Abstract -** *The first occurrence of ophiuroids (Ophiuroidea, Echinodermata) in the Early Triassic of Lombardy (Northern Italy).* Early Triassic ophiuroids findings are quite rare worldwide. The discovery of a dense ophiuroids assemblage, aged to Spathian, can be therefore considered an exceptional event. This is the first occurrence of ophiuroids (*Ophiuroidea, Echinodermata*) in the Early Triassic Lombardy subalpine area, the second one for Italy after that Broglio Loriga & Berti Cavicchi (1972) described the genus *Praeaplocoma* from the Werfen Formation of the Dolomites (Northern Italy). This assemblage came from the Servino Formation that can be considered the lateral equivalent of the Werfen Formation. *Praeaplocoma* shares several characters with the ophiuroids described in the present paper and referred to the subfamily Ophiurinae. This discovery is a new evidence of how these organisms inhabited the Paleo-Tethys shallow sea after the great Permo-Triassic extintion event.

**Key words -** Ophiuroids, Lombardy, Servino, Werfen, Ophiurinae, Early Triassic.

**Riassunto -** *Primo rinvenimento di ofiuroidi (Ophiuroidea, Echinodermata) nel Triassico Inferiore della Lombardia (Italia settentrionale).* I ritrovamenti di ofiure del Triassico Inferiore sono piuttosto rari a livello mondiale. La scoperta di un denso ammasso di ofiuroidi databili allo Spathiano costituisce pertanto un rinvenimento eccezionale. La prima testimonianza nel Triassico Inferiore del Sudalpino lombardo per gli ofiuroidi (*Ophiuroidea, Echinodermata*), la seconda in Italia, dopo che Broglio Loriga & Berti Cavicchi (1972) hanno descritto il genere *Praeaplocoma* dalla Formazione di Werfen delle Dolomiti (nord Italia). Questo ammasso proviene dalla Formazione del Servino che può essere considerata l'equivalente laterale della Formazione di Werfen. Le *Praeaplocoma* hanno molti caratteri in comune con gli ofiuroidi descritti nella presente pubblicazione e riferiti alla sottofamiglia Ophiurinae. Questa scoperta costituisce una nuova testimonianza di come questi organismi abitassero le zone costiere della Paleo-Tetide, colonizzate in seguito al grande evento estintivo Permo-Triassico.

**Parole chiave -** Ofiuroidi, Lombardia, Servino, Werfen, Ophiurinae, Triassico Inferiore.

## Introduction

In this paper I describe the first occurrences of an Early Triassic ophiuroid assemblage found in the dolomitic marls of the Servino Formation. The fossil record was found in the fields surrounding Passo San Marco in the province of Bergamo, Northern Italy (GPS 46.036152, 9.62981) at an altitude of about 1740 meters (Fig. 1).

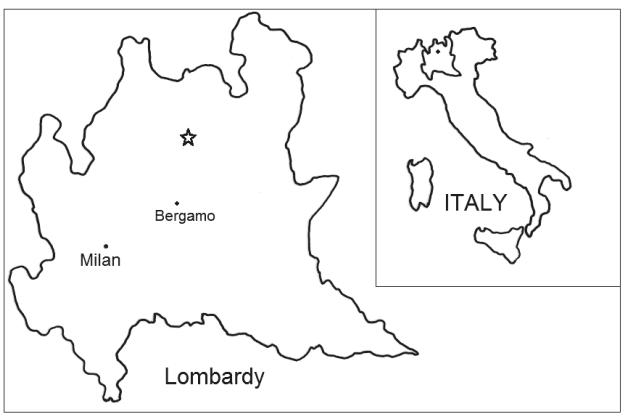


Fig. 1 - Geographic location of the specimens discussed in this study. The star indicates the Passo San Marco area, Bergamo province, Italy. (GPS 46.036152, 9.62981), about 1740 m a.s.l.

Early Triassic ophiuroids from subalpine foothills of Italy are already known in literature but neither from Lombardy nor from the Servino Formation. Previous works by Broglio Loriga & Berti Cavicchi (1967, 1972) and Twitchett *et al.* (2005) described ophiuroid fossil records coming from the Werfen Formation of the Dolomites, but up to the present work there was no evidence of equivalent findings in the Lombardy corresponding facies. So this discovery could be very important as both locations were coastal areas of the same marine basin and the Servino Fm. can be considered the lateral equivalent of the Werfen Fm. (see Geological Setting).

Even if no previous record from Early Triassic is known, for Middle and Late Triassic of Lombardy three ophiuroid records are reported in literature: *Ophiurella lariensis*, *Ophioderma torrii* and *Aspidura camuna*. *Ophiurella lariensis* (referred to the genus *Aplocoma* by Hess, 1965: p. 159) was described by Airaghi (1908) from the Raethian sediments of Limonta, Como lake. Few characters are in common with the specimens described in the present paper: pentagonal disc, 4 mm in diameter, arms about 33 mm (more or less 8 times the diameter disc), lateral shields swollen with strong and erect arm spines, longer than a seg-

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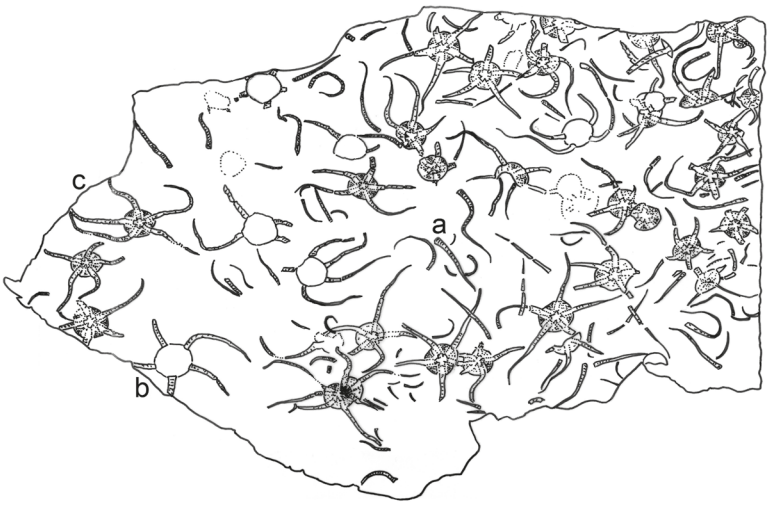


Fig. 2 - Overall view of slab MSNVI 035/038 with monospecific ophiuroids (Ophiurinae) Lyman, 1865. a= ophiuroid disarticulated arm, shown in detail in Fig. 3; b=ophiuroid with dorsal side up shown in detail in Fig. 4; c=ophiuroid with oral side up (detailed in Fig. 6). Scale bar represents 10 mm.

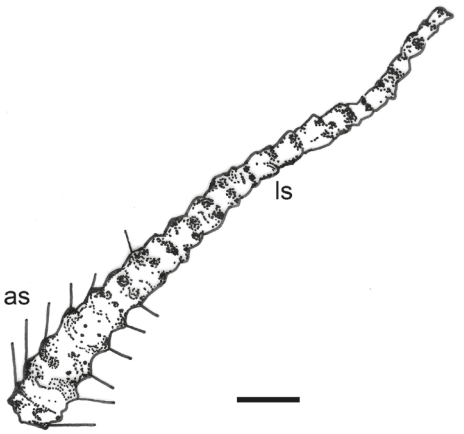


Fig. 3 - Ophiuroid (Ophiurinae) Lyman, 1865. Lower Triassic (Spathian) Servino Formation (Myophoria beds) of Passo San Marco in the Bergamo province, Northern Italy. Disarticulated arms from slab MSNVI 035/038. Arm spines erect, divergent and longer than segment. as=arm spines; ls=lateral shield. Scale bar represents 1 mm.

ment. *Ophioderma torrii* (referred to the genus *Aplocoma* by Hess, 1965: p. 161-163) was described by Desio (1951) from the Raethian of the Albenza mount, close to Bergamo. Few characters are in common with the specimens described in the present paper: subpentagonal disc, 5-6 mm in diameter, arms long 5 times the diameter disc, 25-30 segments with arm spines short and adpressed. *Aspidura camuna* was described by Rossi Ronchetti (1965) from the Late Triassic of Val Camonica, Eastern Lombardy.

The record reported in the present paper, establishes not only a new location for this class of echinoderms but also describes an exceptionally dense community of organisms, that carpets the four slabs collected with tens of individuals concentrated in small areas. The best preserved finding (MSNVI 035/038) shows no less than 35 ophiuroids carpeting a slab with an area of 65 squared centimeters (Figg. 2, 3).

## Paleontological Context

The mass extinction event occurred at the end of Permian (P-Tr boundary) had a great impact on biodiversity (Benton, 2003), causing the extinction of 96% of the marine species (Raup, 1979). In contrast with this biotic crisis, that affected echinoderms as most of the other organisms (Erwin, 1993), Ophiuroidea seem to increase in diversification after the end-Permian evolutionary bottleneck, suffering only at genus and species levels but not at family level. In fact, even if all the Paleozoic genera of ophiuroids get lost, after the event the number of species increased (Chen *et al.*, 2005; Twitchett *et al.*, 2005) as a rapid radiation occurred worldwide in the post extinction oceans. The ecological niches freed by the biological crisis were opportunistically occupied by this clade adapting to different life habitats: shallow sea, nearshore, platform to offshore (Chen *et al.*, 2005; Smith *et al.*, 1995), in accord to what reported by Erwin (1998) about the increase in diversity happening immediately after a mass extinction event.

The post extinction recovery time of Ophiuroidea is in sharp contrast with other clades. For example gastropods and reef builders recovered in 5 Ma (Hallam, 1991; Erwin 1993, 1998, 2000, 2001) while ophiuroids in only 1-2 Ma after the event (Chen *et al.*, 2005), meaning that they quickly adapted to new habitats, as confirmed by the fossil record. The earliest taxon recorded after the P-Tr crisis, *Huangzhishania permotriassica,* is aged to Griesbachian and was described by Chen *et al.* (2004) from China. Then Ophiuroids radiation became important during the Olenekian with at least seven species in the Smithian and nine in the Spathian (Chen *et al.*, 2005). Olenekian Ophiuroid communities were locally diverse: dominant in certain cases with great assemblages carpeting the substrate, while in other cases it was just a small presence in the benthic communities (Twitchett *et al.*, 2005).

However after the evolutionary bottleneck, ophiuroid taxa have been abundant and worldwide distributed with occurrences in Australia, China, Germany, Hungary, Northern Italy, Pakistan and US (Nevada) (Chen *et al.*, 2004, 2005). Example of gregarious dense com-

munities were found in slabs showing large monotaxic assemblages coming from Northern Italy and Nevada (US), both sites located at similar paleolatitudes, even if on opposite sides of Pangea, during the Early Triassic. Ichnofossil records of *Asteriacites lumbricalis* were found in the Werfen Formation of Northern Italy and in the Thaynes and Moenkopi Formations of Nevada (US), witnessing that ophiuroid dispersal occurred either in Paleo-Tethys and Panthalassa. Both facies were deposited in a mixed carbonate-siliciclastic, shallow marine setting, above storm wave base (Twitchett *et al.*, 2005) and according with Seilacher (2007), *Asteriacites lumbricalis* can be interpreted as undertraces left by ophiuroids.
Broglio Loriga & Berti Cavicchi (1967, 1972) described an exceptional assemblage of *Praeaplocoma hessi*, an ophiuroid specie discovered in the Olenekian of the Werfen Formation (Val Badia member of Spathian age) of the Dolomites in Northern Italy. These are the only species aged to Early Triassic described in literature and ever found in subalpine foothills of Italy. In the same Werfen Formation, Broglio Loriga *et al.* (1990), Malaroda (1952) and others described several findings of *Asteriacites lumbricalis* trace fossils (abundant in the Campil member aged to Smithian) emphasizing the quick recovery of this clade.

## Geological Setting

During the Permian, the Subalpine foothills of Lombardy were a floodplain environment. At the Permo-Triassic transition a great tectono-eustatic transgressive events (Sciunnach *et al.*, 1999) caused the sea level to increase with an E-W orientation (Assereto *et al.*, 1973) changing this continental alluvial landscape in an extended tidal plain with shallow water (Sciunnach *et al.*, 1996, 1999). So, at the beginning of Mesozoic, Northern Italy was characterized by an extended shelf environment where coastal areas were located in the south and west areas of the basin (now the Lombardo - Veneto plains). On the contrary in the north and east regions the sea depth was greater.
Casati *et al.* (1967) recognized this paleoenvironment in the sediments of the Servino Formation. This facies lies over the continental red beds deposit of the Verrucano Lombardo (Sciunnach, 2007). The Servino Formation extends almost from one side to the other of Lombardy, from Campione d'Italia to the Giudicarie valleys (Sciunnach, 2007). Outcrops are particularly diffused in the high Brembana valley (Jadoul *et al.*, 2000) and generally in the Orobic Prealps. This unit has an average thickness of about 150 meters (Sciunnach, 1999), with a peak of 300 meters in the Como lake area, but only 10 meters in the surroundings of Campione d'Italia (Sciunnach, 2007). On the basis of its faunal content it is aged to Early Triassic: Induan – Olenekian (Sciunnach, 1999; Jadoul *et al.*, 2000).
Etymology of this unit came from Brocchi (1808) that named it Servino because the Valtrompia inhabitants (Brescia province) used to call with this name the micaceous-rich clay schist they mined from the iron ore. This name is still valid today and describes a transitional to marine sediment succession (Sciunnach, 2007).
The Servino Formation is the lateral equivalent of coeval Werfen Formation (Twitchett, 2000) that outcrops in the Dolomites, even if the Servino Fm. is thicker (300 m vs. 450 m) due to lower subsidence rate in Lombardy (Sciunnach *et al.*, 2007; Twitchett, 2000). We can find the same lithological and sedimentological characters also in several other coeval alpine formations (Salisburg, Transdanubian, Bukk, Karawanke, Dinarids, etc.) that could be grouped under a single name (Neri, 2007).
Six informal members can be recognized in the Servino Formation (Prato Solaro mb., Cà San Marco mb., Gastropod oolite, Acquaseria mb., Myophora beds, Upper mb.) and a correlation with the nine formally recognized members of the Werfen Formation has been initially suggested by Broglio Loriga (1990) and subsequent works of Sciunnach (1999, 2007).
On the base of lithological characteristics and faunal content, the specimens here described probably were hosted in the Myophoria beds mb. In this member we can find bioclastic and oolitic limestones intercalated to brown to green marls with common siderite mineralization (Sciunnach, 2007). The fossil content consists in an oligotipic fauna with gastropods: *Natiria costata, Natiria semicostata, Turbo rectestatus;* bivalves: *Costatoria costata, Bakevellidae, Neoschizodus ovatus;* and ammonoids: *Tirolites* sp., *Dinarites* sp. (Broglio Loriga *et al.*, 1983, 1986; Sciunnach *et al.*, 1999; Sciunnach, 2007). These taxa suggest a Spathian age even if a stratigraphic correlation is not possible as specimens were collected from debris (Sciunnach *et al.*, 1999, 2007). According to Sciunnach (1999) the Myophoria beds should be roughly equivalent to the Val Badia mb. (first occurrence of *Tirolites* and *Natiria costata*) and the lower part of the Cencenighe mb. of the Werfen Formation (aged to Spathian).

## Material

The specimens described in this study were found in debris of the Servino Formation outcrops next to Passo San Marco (BG) in Northern Italy. This material is currently deposited in the Natural History Museum "Antonio Stoppani" located in Venegono Inferiore (VA), Italy, referenced as MSNVI.

Specimens are catalogued as MSNVI 033/038, MSNVI 034/038, MSNVI 035/038, MSNVI 036/038 and they all show the same lithological characteristics (detailed only for the first specimen discussed) and the same monospecific faunal content.
MSNVI 033/038 is a 5.5 x 4.5 x 0.2 cm brown-greenish slab of dolomitic marl with brownish iron oxides inclusion, probably siderite. Ophiuroids are light brown in color and they densely carpet the area of 25 $cm^2$ with almost 50 articulated organisms (about 17 in dorsal position and 33 in ventral position), with an average size of 3-4 mm (complete animal).
MSNVI 034/038 is a 7 x 5 x 0.3 cm slab. Ophiuroids are light brown in color and they densely carpet the area of 35 $cm^2$ with almost 65 articulated organisms (61 dorsal, 4 ventral), with an average size of 3-4 mm (complete animal). On the opposite side of the slab there is a 2 cm long crawling trace fossil roughly parallel to the bedding surface.
MSNVI 035/038 (Fig. 2) is a 10 x 6.5 x 0.4 cm slab. Ophiuroids are light brown in color and they densely carpet the area of 65 $cm^2$ with no less than 35 articulated organisms (9 dorsal, 26 ventral), with an average size of 10-15 mm of the complete animal (disc diameter 4 mm). Most of them are articulated and complete but also disarticulated arms are present. This slab is the most representative for number of individuals, size and completeness of the ophiuroids.
MSNVI 036/038 is a 7 x 2.7 x 1 cm slab. Ophiuroids are light brown in color and they densely carpet an area of 14 $cm^2$ with almost 4 articulated organisms (all ventral), with an average size of 10 mm of the complete animal (disc diameter 7 mm). Moreover the sediment partially hides at least a couple of additional ophiuroids.
Ophiuroids on slabs MSNVI 033/038 and MSNVI 034/038 are very small, three times smaller than the MSNVI 035/038 and MSNVI 036/038 specimens, and it is supposed that they are juvenile specimens since all the organisms seem to share the same morphological characters and, generally, dense ophiuroid assemblages from the same site are monospecific (H. Hess personal communication). So I consider this assemblages as monotaxic.
I have to remark that all these slabs were found together with other macrofossils discovered in the same area and coming from the same facies. These specimens, deposited in the MSNVI either but not discussed in the present paper, represent a benthic fauna mainly constituted by gastropods like *Natiria costata* (MSNVI 049/038) and bivalves like *Bakevellia* sp. (MSNVI 039/038) together with ammonoids as *Tirolites* sp. (MSNVI 045/038 and MSNVI 046/038). Occurences of the same fossil contents can also be found in the Val Badia mb. of the Werfen Formation, where *Praeaplocoma hessi* was found too (Broglio Loriga & Berti Cavicchi, 1972).
According with (Sciunnach *et al.*, 1999, 2007) and due to the faunal content and facies characteristics, I consider all these specimens stratigraphically coming from the Myophoria beds of the Servino Formation, aged to Spathian. (same of Val Badia mb. and the lower part of the Cencenighe mb. of the Werfen Fm.)

## Systematic Palaeontology

The systematic palaeontology ophiuroids can be summarized as follows:

| | | |
|---|---|---|
| Phylum | Echinodermata | Klein, 1754 |
| Subphylum | Asterozoa | Zittel, 1895 |
| Class | Ophiuroidea | Gray, 1840 |
| Order | Ophiurida | Müller and Troschel, 1840 |
| Family | Ophiuridae | Lyman, 1865 |
| Subfamily | Ophiurinae | Lyman, 1865 |

## Description

In MSNVI 035/038 and MSNVI 036/038 ophiuroids present the following characters: disc diameter 4 mm wide (on average), complete size (disc and arms) ranging between 10 and 15 mm (12 mm on average), disc shape round (subpentagonal), oval in certain cases but due to

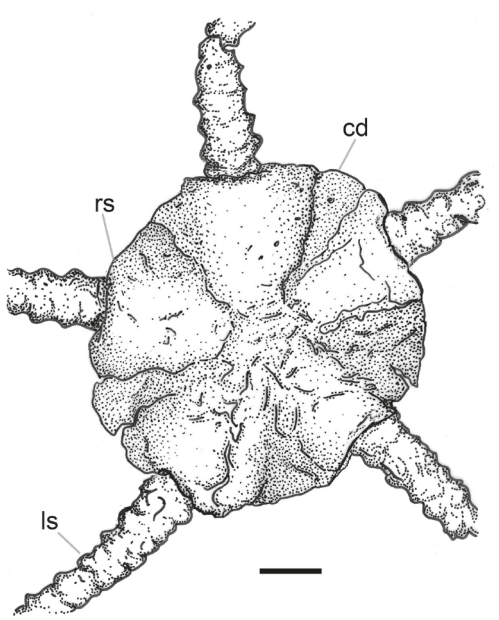


Fig. 4 - Ophiuroid (Ophiurinae) Lyman, 1865. Lower Triassic (Spathian) Servino Formation (Myophoria beds) of Passo San Marco in the Bergamo province, Northern Italy. From slab MSNVI 035/038. Dorsal view showing central disc and radial shields eroded but moderately large. cd=central disc; ls=lateral shield; rs=radial shield. Scale bar represents 1 mm.

diagenesis, dorsally covered by granules. The disc is clearly distinguishable from the arms, radial shields are eroded, moderately large, subtriangolar in shape (Fig. 4), equaling the radius length and slightly overlapped proximally. Distally convex, they hide the most proximal portion of the arms, interradial depressed.
On the ventral side the conservation is remarkably poor, especially in the mouth region where oral papillae and teeth are heavily weathered and indeterminable. Interradii with scattered granules, oral shields with the distalmost edge slightly flat and overlapping proximally the interradial scales, concave lateral edges in arrow shape. Two genital slits for each interradial, close to the arms, long and slender. Five arms sinuous, long and slender, with a length between 2.5 to 3 times the disc diameter, fused with the disc, composed of 30-35 segments (Figg. 5-6), the most proximal 3 or 4 segments are inside the disc edge. Segments appear to be wider than longer proximally and then longer than wider distally. Arms taper slowly and gradually distally to proximally. Ventrally large round tentacular pores, narrow ventral shields, distalmost edge convex.
Lateral shields are quite swollen distally with arms spines, longer than a segment, strong and divergent proximally (Fig. 3). Due to the poor status of conservation, any other character (i.e. mouth region) is indeterminable due to extensive weathering and erosion of the slabs.

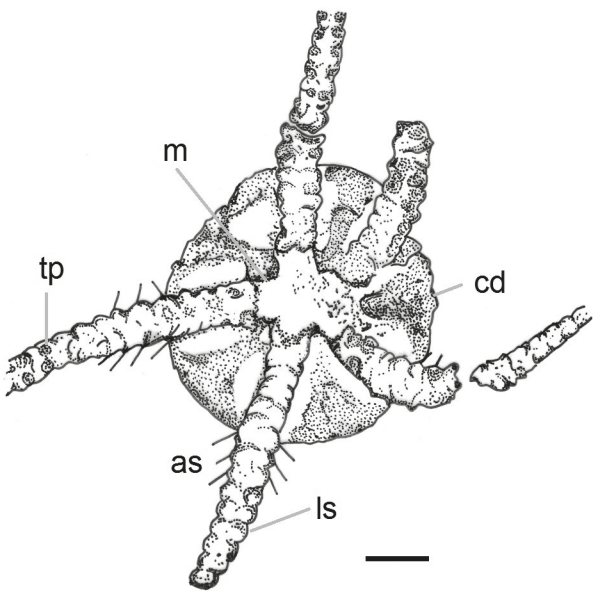


Fig. 5 - Ophiuroid (Ophiurinae) Lyman, 1865. Lower Triassic (Spathian) Servino Formation (Myophoria beds) of Passo San Marco in the Bergamo province, Northern Italy. From slab MSNVI 036/038. Ventral view showing central disc and arm segments with divergent arm spines. as=arm spines; cd=central disc; ls=lateral shield; m=mouth; tp=tentacular pore. Scale bar represents 1 mm.

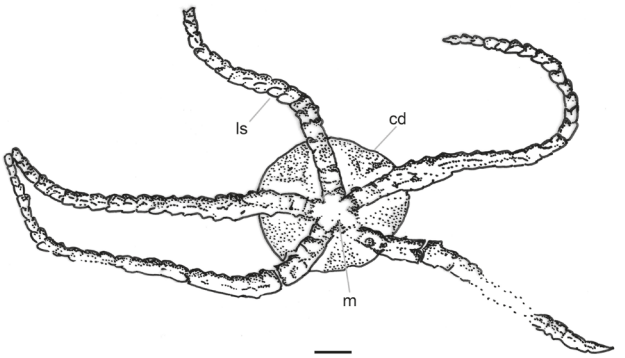


Fig. 6 - Ophiuroid (Ophiurinae) Lyman, 1865. Lower Triassic (Spathian) Servino Formation (Myophoria beds) of Passo San Marco in the Bergamo province, Northern Italy. From slab MSNVI 035/038. Ventral view showing central disc and stretched arms. cd=central disc; ls=lateral shield; m=mouth. Scale bar represents 1 mm.

MSNVI 033/038 and MSNVI 034/038 show very small ophiuroids, three or four times smaller than MSNVI 035/038. About 3-4 mm as a whole (disc and arms), almost incomplete, especially distally. Discs are small in diameter and arms are short, one or two times the disc diameter. Both these slabs show juvenile individuals of the same taxon, in a poor status of conservation.

## Discussion

The records discussed in the present paper share with the genus *Praeaplocoma* Broglio Loriga & Berti Cavicchi (1972) the following characters: round (subpentagonal) disc shape dorsally covered by granules, radial shields moderately large, oral shields with concave lateral edges in arrow shape, two long and slender genital slits for each interradial, five arms long and slender, long between 2.5 to 3 times the disc diameter, composed of 30-35 segments, the most proximal 3 or 4 segments are inside the disc edge, ventral large round tentacular pores, narrow ventral shields, lateral shields quite swollen distally with arms spines, longer than a segment, strong and divergent. On the contrary the ophiuroids here described differ from *Praeaplocoma*, whose arms taper rapidly after the $9^{th}$-$10^{th}$ segment, for their slender arms tapering very gradually.
Thanks to the analysis of 43 morphological characters in extant ophiuroids, Smith *et al.* (1995) revised the ophiuroid taxonomy adopted by Matsumoto (1915, 1917) according to the previous anatomical work of Lyman (1865, 1882). In the Smith *et al.* (1995) recommended classificatory scheme, the family Ophiuridae was positioned under the Chilophiurida clade and splitted in two subfamilies: Ophiurinae Lyman 1865

and Ophioleucinae Matsumoto 1915. Also the family Aplocomidae Hess 1965 was considered as part of Chilophiurida. To this last family are referred the earliest reliable stratigraphical records for ophiuroids (Smith *et al.*, 1995) with disc plate densely granulated, arms long and slender. Hess *et al.* (2008) reviewed the Aplocomidae family erecting two new subfamilies: Aplocominae (arm spines small, adpressed, inserted in indistinct socket) and Ophiopetrinae (arm spines robust, erect, and inserted in distinct socket). These two subfamilies can be distinguished mainly by the development of the arm spines. In this review the genus *Praeaplocoma*, previously under Aplocomidae, was moved to the Ophiurinae subfamily because, even if the morphology resembles the Aplocomidae, the rapidly tapering arms and the swollen lateral plates prevent the assignment to this family.

It is remarkable that high weathering and poor preservation prevent us to identify the Passo San Marco records at the genus level and this is especially true for the mouth region undeterminable, the eroded lateral shields, and the dorsal side where granulation of the disc is slightly notable. This last could mean that a dense granulation was present but not noticeable due to erosion or that the disc was not densely granulated at all, and this will prevent their classification under Aplocomidae (Hess *et al.,* 2008). This even if Thuy *et al.* (2012) noted that the previously assumed distinctive characters of the Aplocomidae family should be revised as their main characters combination are not unique.

On the base of these observations I put the specimens described in the present paper under the Ophiurinae subfamily of Ophiuridae, together with the genus *Preaplocoma* and *Aspiduriella,* which share several characters. A more detailed determination could be only speculative, as ophiuroid systematics is based almost exclusively on external characters of the calcitic skeleton (Thuy *et al.*, 2012) and records calcitic and not tridimensional cannot be determined at higher level just on the base of the overall morphology (C.A. Meyer & H. Hess personal communication).

## Palaeoecology and Taphonomy

The ophiuroid monotaxic assemblage here described are the remnants of a colony of opportunistic organisms that inhabited the floor of a shallow sea after the Permian-Triassic extinction event. Most of these organisms are completed with discs and arms in anatomic connections and arms stretched, suggesting their death to have been caused, or immediately followed, by a sudden burial. Usually storms are the most likely candidates for effective burial of the articulate brittle stars skeletons (Twitchett *et al.*, 2005), and according to this interpretation, ophiuroids were smothered by the sediment, in the place where they lived or immediately nearby. The sudden burial prevented these organisms from the rapid decay and from the disarticulation of arms and other skeletal parts which, in Early Triassic ophiuroids, is hypothesized to begin very soon, even 15 hours after the death (Twitchett *et al.*, 2005). Some other information come from the orientation of specimens, as ventrally oriented, which is apparently opposite to the life position with the oral side facing down, organisms are significantly present in all the four slabs (66% in 033/038; 6% in 034/038; 74% in 035/038; 100% in 036/038). Even if a certain percentage of oral surfaces oriented upward is common in extant ophiuroid communities (Fujita *et al.*, 1989) and the temporary overturn can also be due to a change in body posture (Shroat Lewis, 2007), a fossil assemblage with ophiuroids dorsally and ventrally oriented mixed up suggests the occurrence, before the burial, of a limited transportation maybe due to storm currents (Twitchett *et al.*, 2005). In any case the completeness of these ophiuroids suggests that transport was limited in both strenght and distance. A short transportation could be also the cause of the breakage of several articulated arms that can be individually recognized in the assemblage; anyway, as the separated arms are close to the rest of the body, it may also be a post burial breakage related to the crawling activity of bottom organisms as I can remark on specimen MSNVI 034/038 where a crawling trace fossil can be noted, roughly parallel to the bedding surface. A different condition is visible on slabs MSNVI 033/038, and MSNVI 034/038 bearing juvenile ophiuroids, very small with short arms not yet developed. In certain case arms are broken and the disarticulated arms are missing, probably not conserved because their small size and light weight amplified the effects of a not necessarily higher energy storming event.

## Conclusions

The fossil assemblage coming from the Servino Formation and aged to the Spathian shows a dense, gregarious, monospecific community of ophiuroids assigned to the subfamily Ophiurinae. This is the first ophiuroid record from the Early Triassic of Lombardy. The second one from Italy after *Praeaplocoma hessi* that has several characters in common, both from the morphological point of view and for what concerns age and facies. The poor status of conservation prevents a more precise determination. In the future, the discovery of new and better preserved occurrences of this same typology of ophiuroids could improve the conclusions of the present work.

ACKNOWLEDGEMENTS

I would like to thank Prof. Elio Gentili, Director of Natural History Museum "Antonio Stoppani" in Venegono Inferiore (VA) that allowed me to study the specimens in his care. Thanks also for his support in looking for rare literature. Great thanks to Prof. Hans Hess for his observations and comments about the determination of these specimens. Thanks also to Christian A. Meyer (Natural History Museum Basel). Finally my gratitude goes to Maria Elena Platé with whom I'm greatly indebted for the wonderful ophiuroids sketches she made for this paper.

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(*ms. pres. il 15 dicembre 2013, ult. bozze il 20 dicembre 2014*)