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HYPERCALCIFIED SPONGES FROM A SMALL REEF WITHIN THE NORIAN-RHAETIAN NAYBAND FORMATION NEAR YAZD, CENTRAL IRAN

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Abstract. Sponges are, beside of scleractinian corals the most abundant reef building organisms in Norian-Rhaetian reefs or reefal limestones of Iran. The sponge fauna from a small biohermal reef structure near the town of Yazd is described. Tectonically it belongs to the so called "Yazd-Block". All described species are hypercalcified sponges, only one species of chambered hexactinellid was found. The chambered species *Welteria lutensis* n. sp. is described.

Riassunto. I poriferi sono, dopo gli Scleractinia, i più abbondanti organismi costruttori nei calcari recifali del Norico e del Retico in Iran. Viene qui descritta una fauna a poriferi proveniente da una piccola struttura biohermale situata presso la città di Yazd. Da un punto di vista geostrutturale essa appartiene al cosiddetto "Blocco di Yazd". Tutte le specie descritte sono spugne ipercalcificate, mentre è stata trovata una sola specie di hexactinellidi camerate, che viene descritta come la nuova specie *Welteria lutensis* n. sp.

Introduction

Hypercalcified sponges, including the chambered "sphinctozoans", non-chambered "inozoans", "spongiomorphid" and "chaetetids" are, in addition to scleractinian corals, the most abundant reef builders in reefs and reefal limestones sandwiched within the siliciclastic-carbonatic deposits of Nayband Formation, east and central Iran. General work on the distribution of the Nayband Formation in Iran is published by Seyed-Emami (2003) and research about the facies and depositional environment was published by Fürsich et al. (2005). Sponges of the reefs within the Nayband Formation were published by Senowbari-Daryan et al. (1997), Senowbari-Daryan & Hamedani (1999), Senowbari-Daryan (2003, 2005a, 2005b, 2009a), and Rashidi & Senowbari-Daryan (in press). References about the other organisms, occurring in the Nayband Formations are found in Senowbari-Daryan (2009a).

New localities of the Nayband Formation were uncovered in Yazd block, near the town of Yazd in east Iran. Several small reefs with an height of about 30-50 m and laterally extension of less than 60 m are exposed within the Nayband Formation in this area. The reefs were formed by dendroid and cerioid corals and different groups of sponges mentioned above. Representatives of chambered "sphinctozoans" and non-chambered "inozoans" are the most abundant sponges among the above mentioned sponge groups. Only one chambered specimen of hexactinellid sponges was found and referred to the genus *Casearia*.

Locality

The study area is located approximately one km southwest of the town of Yazd in central Iran. Tectonically belonging to the "Yazd block", the locality is situated on the geological quadrangle map of Yazd (Fig. 1). The area is covered by the youngest member of the siliciclastic-carbonatic Nayband Formation, the so called Howz-e Khan member. Lithological characteristics of the deposits indicate the carbonate layers to be the upper part of this member. The Kowz-e Sheikh member, being the underlying member of the Kowz-e Khan is not exposed in this area. The resistant reef or

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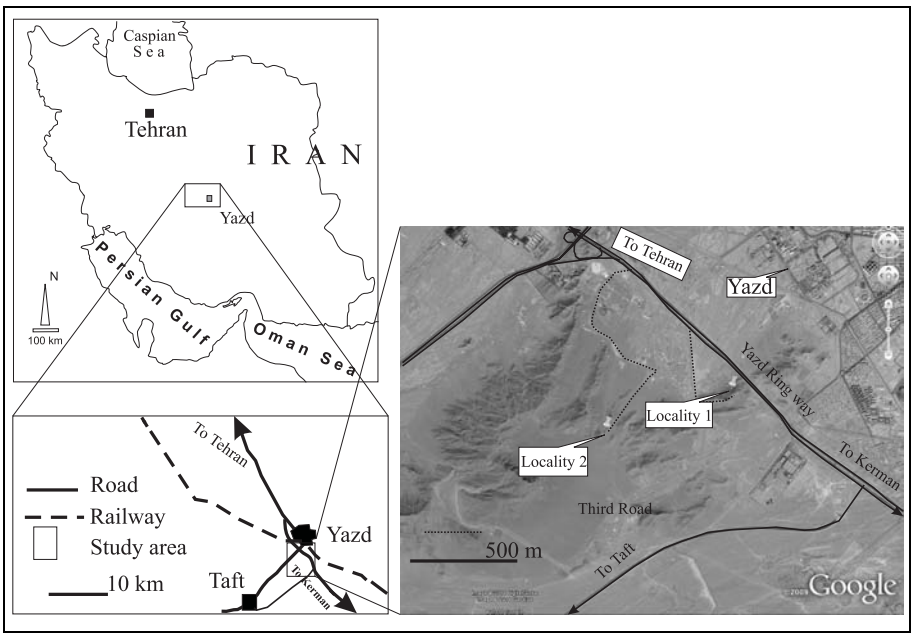


Fig. 1 - Geographic position of the investigated reef near the town of Yazd. Coordinates: Locality 1: N: 31° 49' 5.17" E: 54° 20' 28.73" Locality 2: N: 31° 48' 44.41" E: 54° 19' 11.23"

Fig. 2 - Field photograph shows the massive reef structure and the surrounded bedded deposits.

reefal limestones usually account for the hills of the area (Fig. 2). In a southeast direction, the Nayband Formation is cut by a fault bounded by the Palaeocene conglomerate. Northward the investigated reef carbonates are bordered by oolitic limestone of Howz-e Khan member, and this passes into the alluvial deposits of the Ardakan-Yazd basin.

The locality can be found by the taking of the road around the Yazd ("ringway" Yazd), after crossing the road to Taft, and after about 600 m, a second road on the right side leads after about 800 m to the locality (Fig. 1). All sponges, described in this paper were collected from the shaly carbonate beds of the Nayband Formation (see Fig. 2).

Depository. The thin sections of holo-and paratypes of the new species *Welteria lutensis* are deposited in "Bayerische Staatssammlung für Paläontologie und historische Geologie, München (Invetary-Nr. BSGP 2010 I 98-105)".

Systematic Paleontology

Remarks. The systematic classification of Finks & Rigby (2004) with minor modifications is used to describe the sponges in this paper.

Class **Demospongea** Sollas, 1875

Order **Agelasida** Verrill, 1907

Suborder **Porata** Seilacher, 1962

Family Sebargasiidae de Laubenfels, 1955

Subfamily Sebargasiinae Senowbari-Daryan, 1990

Genus *Amblysiphonella* Steinmann, 1882

Type species: *Amblysiphonella barroisi* Steinmann, 1882

Further species: See Remarks.

Remarks. More than 50 species of *Amblysiphonella* are known from Paleozoic and Triassic time interval and are listed by Senowbari-Daryan & Garcia-Bellido (2002). It is an abundant sponge genus within the reefs and shallow water deposits in Upper Paleozoic and Triassic. The genus is also abundant in Permian shallow water carbonates in Iran. *Amblysiphonella iranica* was described from the Permian of a locality north of Esfahan by Senowbari-Daryan & Hamedani (2002), central Iran, *A. rigbyi* from the Permian of Shotori Mountains northeast Iran by Senowbari-Daryan et al. (2005), and *A. hambastensis* by Senowbari-Daryan et al. (2007) from the Permian of Hambast Mountains, south of Abadeh in central Iran. The genus occurs also in the reefs of Nayband Formation but it is not an abundant sponge. Several species of *Amblysiphonella* (without species determination and *A. najafiani*) were described from the reefs of the Nayband Formation by Senowbari-Daryan (2005a) and two new species as *A. torabii* and *A. biporata* by Rashidi & Senowbari-Daryan (in press). Further new species of *Amblysiphonella* were established as *A. adnetensis* by Senowbari-Daryan & Bernecker (2009) from the Rhaetian of Adnet-reef, Austria and as *A. agahensis* from the Norian of Oman by Senowbari-Daryan & Bernecker (2010).

Only one species of *Amblysiphonella* was found in the studied limestones from the reefs near the town of Yazd and is here described as *Amblysiphonella* sp. 1.

Amblysiphonella sp. 1

Pl. 1, Fig. D-E

Material: Two specimens. One specimen is illustrated in Pl. 1, Fig. D (thin section N37) and from the other one (Fig. E) only a field photograph is available.

Description. The specimens of this *Amblysiphonella* are moderately large having diameters between 1.1 cm and 1.2 cm. It is composed of numerous flattened ring-shaped chambers. The chambered construction of the species is hardly recognizable from the outside of the sponge. A spongocoel of about 2-3 mm in diameter passes internally through the sponge. Thickness of chamber and spongocoel walls is very variable, between 0.1 and 1.0 mm. They are pierced by numerous single pores of 0.2-0.6 mm measured in inter- and endowalls. The exowalls are strongly recrystallized and the perforation of the walls is not recognizable. Chamber interiors are without vesicualae and other types of filling skeleton.

Remarks. *Amblysiphonella* is not an abundant sponge in Triassic reefs in Iran. Two species were described as *A.* cf. *steinmanni* (Haas, 1909) and *A.* cf. *tubifera* Senowbari-Daryan (1994) from the Nayband Formation near Wali Abad, SE of Abadeh, central Iran by Senowbari-Daryan & Hamedani (1999). The new species *A. najafiani* and additionally three informally species were described by Senowbari-Daryan (2005a).

The chamber shape and the perforation pattern of the specimen, described here from the locality near the town of Yazd differs this species from other species mentioned above. Most probably it is a new species, but because it is only represented by one specimen, we describe it as *Amblysiphonella* sp. 1.

Family Polytholosiidae Seilacher, 1962

Subfamily Polytholosiinae Senowbari-Daryan, 1990

Genus *Nevadathalamia* Senowbari-Daryan, 1990

Type species: *Polytholosia cylindrica* Seilacher, 1962

Further species: See Senowbari-Daryan, 2005a.

Nevadathalamia variabilis Senowbari-Daryan, 2005a

Pl. 1, Fig. F-G

2005 *Nevadathalamia* sp. - Fürsich et al., pl. 7, fig. 5.

2005a *Nevadathalamia variabilis* nov. sp. - Senowbari-Daryan, p. 185; pl. 10, fig. 1-6, 7?; pl. 11, fig. 1-6; pl. 28, fig. 12-14.

Material: Two specimens are available in collection and both are cut in tangential or oblique tangential sections. Specimen illustrated in Pl. 1, Fig. G shows the chambered construction of the sponges. The determination of the sponge as *N. variabilis* is based on the tubular filling skeleton within the chamber interiors, the perforated chamber walls and the diameter of the sponge. For the detail description of this species see Senowbari-Daryan (2005a).

Occurrence. *N. variabilis* is an abundant sponge species in several reef localities of the Nayband Formation in east and central Iran (for more information see Senowbari-Daryan 2005a). The sponge in not abundant in investigated reef limestone in Yazd block.

Family Solenolmiidae Engeser, 1986

Synonymy: Deningeriidae Boiko, 1991 (in Boiko et al. 1991)

Genus *Senowbaridaryana* Engeser & Neumann, 1986

Type species: *Verticillites triassicus* Kovacs, 1978

Senowbaridaryana raretrabeculata (Boiko, 1991)

Pl. 1, Fig. H

1991 *Polycystocoelia raretrabeculata* sp. nov. - Boiko (in Boiko et al.), p. 155; pl. 46, fig. 1-2.

2005a *Senowbaridaryana raretrabeculata* (Boiko) (in Boiko et al.) nov. com. - Senowbari-Daryan, p. 189-190; pl. 14, fig. 1-4, 6.

Material: One specimen only.

Description. Specimen illustrated in Pl. 1, Fig. H is a broken one and composed of numerous crescent-like chambers. Because of the chamber shape and overlapping of the older chambers by the younger chambers the outer segmentation lacks. The thin chamber walls are pierced by evenly distributed pores. Chamber interiors contain rare reticulate filling skeleton.

Occurrence. Two species of the genus *Senowbaridaryana* - *S. raretrabeculata* and S. *rectangulata* – occur in reefs of Nayband Formation (Senowbari-Daryan 2005a). *S. raretrabeculata* is known from the Norian reefs of Pamir Mountains (Boiko: in Boiko et al. 1991) and from the Norian-Rhaetian reefs within the Nayband Formation in Iran.

Genus *Welteria* Vinassa de Regny, 1915

Type species: *Welteria repleta* Vinnassa de Regny, 1915

Further species: See comparison after the description of the species.

Welteria lutensis n. sp.

Pl. 1, Fig. A, B?, C?; Pl. 3, Fig. A-F; Pl. 4, Fig. A-D

Derivatio nominis: Named from the Lut desert in east Iran.

Holotype: Specimen illustrated in Pl. 4, Fig. A (Inventory-Nr. 2010 I 100).

Paratypes: All specimens illustrated in Pl. 1, Fig. A, B?, C?; Pl. 3, Fig. A-F; Pl. 4, Fig. C-D.

Locus typicus: See Fig. 1.

Stratum typicum: Upper Triassic, Rhaetian.

Diagnosis: Species of *Welteria* with coarse reticulate filling skeleton within the chamber interiors. Two or three spongocoels pass internally through the sponge. Chamber walls with mazelike ("spongy") canal system. Two types of secondary skeleton within the chamber: the first type is secreted within the chamber interior, the second type covers the chamber walls internally. Old chambers are almost totally filled by such secondary skeleton of type 2. Spicules and microstructure of the rigid skeleton are unknown.

Material: 14 specimens in body preserved.

Depository: The thin sections of holo- and paratypes will be deposited in "Staatssammlung für Geologie und Paläontologie in München" (Inventary-Nr. 2010 I 98-105).

Description. After the inozoan genus *Permocorynella*, this species is the most abundant sponge in the locality. Ten completely, preserved specimens, exhibiting all characteristics of the sponge, were cut longitudinally. The straight or curved sponge is composed of several ring-shaped chambers arranged around two or three (recognizable in longitudinal sections) axial spongocoels running internally through the sponge. The length of the sponge depends upon the number of the chambers and its diameter varies between 8 mm and 10 mm. Chamber heights can be variable, varying between 0.2 and 0.5 mm. Chamber interiors contain in some specimens rare in other specimens abundant loose filling skeleton of reticulate type (Pl. 4, Fig. D). The sponge is characteristic by two types of secondary skeleton within the chamber interiors produced by sponge. The first type is of loose reticulate type and not secreted in all specimens, but it is clearly visible in the specimen illustrated in Pl. 4, Fig. C. The second type of filling skeleton is massive and appears white in transmitted light (in almost all specimens illustrated in Pl. 3 and Pl. 4) and dark in polished slab (Pl. 4, Fig. C). This type of secondary skeleton covers the exowalls from inside and therefore the canals system of the exowall. The old chambers may be filled totally by the secondary skeleton of the second type (Pl. 3, Fig. C; Pl. 4, Fig. D). All specimens show this secondary skeleton. However, in

PLATE 1

"Sphinctozoans" and "inozoans" from the small reef near the town of Yazd. Scale in Fig. A-C 5 mm, in all other Fig. 10 mm.

Fig. A, B?, C? - *Welteria lutensis* n. sp. Fig. A - Oblique longitudinal section through four barrel-shaped chambers. The spongocoel is cut in the youngest chamber. The mazelike perforation pattern of the chamber walls allows the assignment of this sponge to *W. lutensis*. Fig. B - Longitudinal section through three chambers. The strong recrystallization does not allow exact species determination. Fig. C - Similar section like Fig. A. Determination as Fig. B.

Fig. D-E - *Amblysiphonella* sp. 1. Fig. D - Longitudinal section through numerous crescent-shaped chambers with thin chamber walls. Fig. E - Field photograph through a broken specimen shows similar characteristics like specimen in Fig. D.

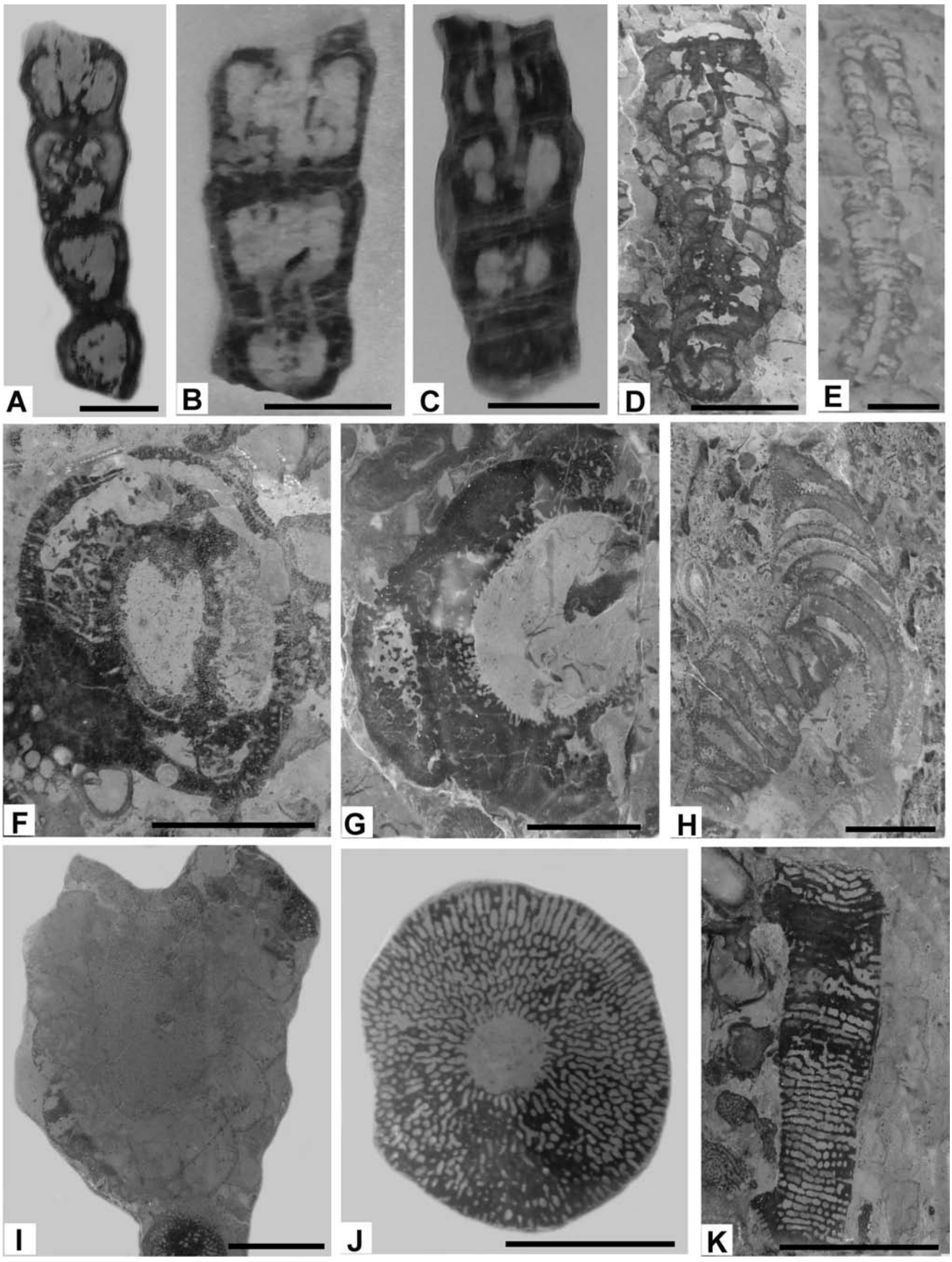
Fig. F-G - *Nevadathalamia variabilis* Senowbari-Daryan. Fig. F - Cross section through a specimen serving as substrate for worms. The tubular filling skeleton is recognizable in parts of chamber interiors. Fig. G - Similar section like Fig. F. The tubular filling skeleton is clearly recognizable within the chamber interior cut obliquely (left in photograph).

Fig. H - *Senowbaridaryana raretrabeculata* (Boiko). Section through numerous chambers of a broken specimen. Crescent-shaped chambers with thin chamber walls. Within the interior of some chambers, the fine reticulate filling skeleton is recognizable.

Fig. I - *Casearia* sp. Longitudinal section through several ring-shaped chambers arranged around the wide spongocoel. The thin chamber walls appear as dark lines.

Fig. J - *Preperonidella norica* (Senowbari-Daryan, Seyed-Emami & Aghanabati). Tangential section. The interfiber spaces radiate from the spongocoel to the outside of the sponge.

Fig. K - *Anguispongia parva* Senowbari-Daryan. Section through the sheet-like sponge shows the fiber skeleton arrange and the interfiber spaces arranged perpendicular to the sheet surface.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the specimen illustrated in Pl. 4, Fig. D this type skeleton is very thin and limited to only two chambers.

The axial spongocoel is composed of several tubes (in section 2 or 3 visible). The walls of the tubes are thick and pierced by large openings. Like other species of the genus the chamber walls are pierced by a mazelike ("spongy") canal systems. (Pl. 3, Fig. C-D, F; Pl. 4, Fig. C-D).

The holotype (Pl 4, Fig. A) is a specimen with at least 13 chambers of variable heights. It shows three spongocoels and clearly reveals the mazelike canal system of the chamber walls (Pl. 4, Fig. B).

Chamber interiors of specimens, illustrated in Pl. 1, Fig. A-C are hollow and seem to be different from the holotype and paratypes, but the mazelike perforation pattern of the chamber walls and the filling skeleton of type 2 allows the assignment of the specimens in Pl. 1, Fig. A as *Welteria lutensis* n. sp. Specimens in B-C in Pl. 1 are assigned with question mark to this species.

Comparison. In addition of the type species – *Welteria repleta* Vinassa – the following species of the genus also are known from the Triassic: *W. fluegeli* Senowbari-Daryan (1990), *W. rhaetica* Senowbari-Daryan (1990), *W. hamedanii* Senowbari-Daryan (2005a), and finally the uncertain species *W.? hawasinensis* from the Permian of Oman described by Weidlich & Senowbari-Daryan (1996).

Welteria lutensis n. sp. differs from all mentioned species by the small dimensions of the sponge and particularly by the massive secondary skeleton of type 2 covering the inside of chamber walls.

Occurrence. *W. lutensis* n. sp. is known only from the type locality.

Order **Agelasida** Verrill, 1907

Family Preperonidellidae Finks & Rigby, 2004

Subfamily Preperonidellinae Finks & Rigby, 2004

Genus *Preperonidella* Finks & Rigby, 2004

Type species: *Preperonidella magna* Rigby & Senowbari-Daryan, 1996

Synonymy: *Peronidella* Zittel (in Hinde 1893) partim.

Preperonidella norica (Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997)

Pl. 1, Fig. J; Pl. 2, Fig. E

1997 *Radiofibra norica* n. sp. - Senowbari-Daryan, Seyed-Emami & Aghanabati, p. 299; Pl. 1, Fig. 1-7; Pl. 2, Fig. 1-6.

2009b *Peronidella norica* (Senowbari-Daryan, Seyed-Emami & Aghanabati) - Senowbari-Daryan, p. 124; Pl. 11, Fig. A, C-D, G-H.

Material: Four specimens.

Description. The cross section of illustrated specimen (Pl. 1, Fig. J) reaches a diameter of 15 mm. Also the diameter of two other specimens is about 15 mm. Specimen, illustrated in Pl. 2, Fig. E reaches a maximum diameter of 25 mm. Inhalant and exhalant canals are lacking in the thick sponge wall. The water current passes through interfiber spaces. In cross section the fiber skeleton radiated from the spongocoel to the sponge outside (Pl. 1, Fig. J). In longitudinal section, the fiber skeleton is arranged divergently upward and outward (Pl. 2, Fig. E). A spongocoel of about 1/5 of the sponge diameter and without its own wall passes internally through the sponge. Within the spongocoel of specimen, illustrated in Pl. 2, Fig. E some secondary skeleton has been secreted. Such type of skeleton was not observed in other specimens.

PLATE 2

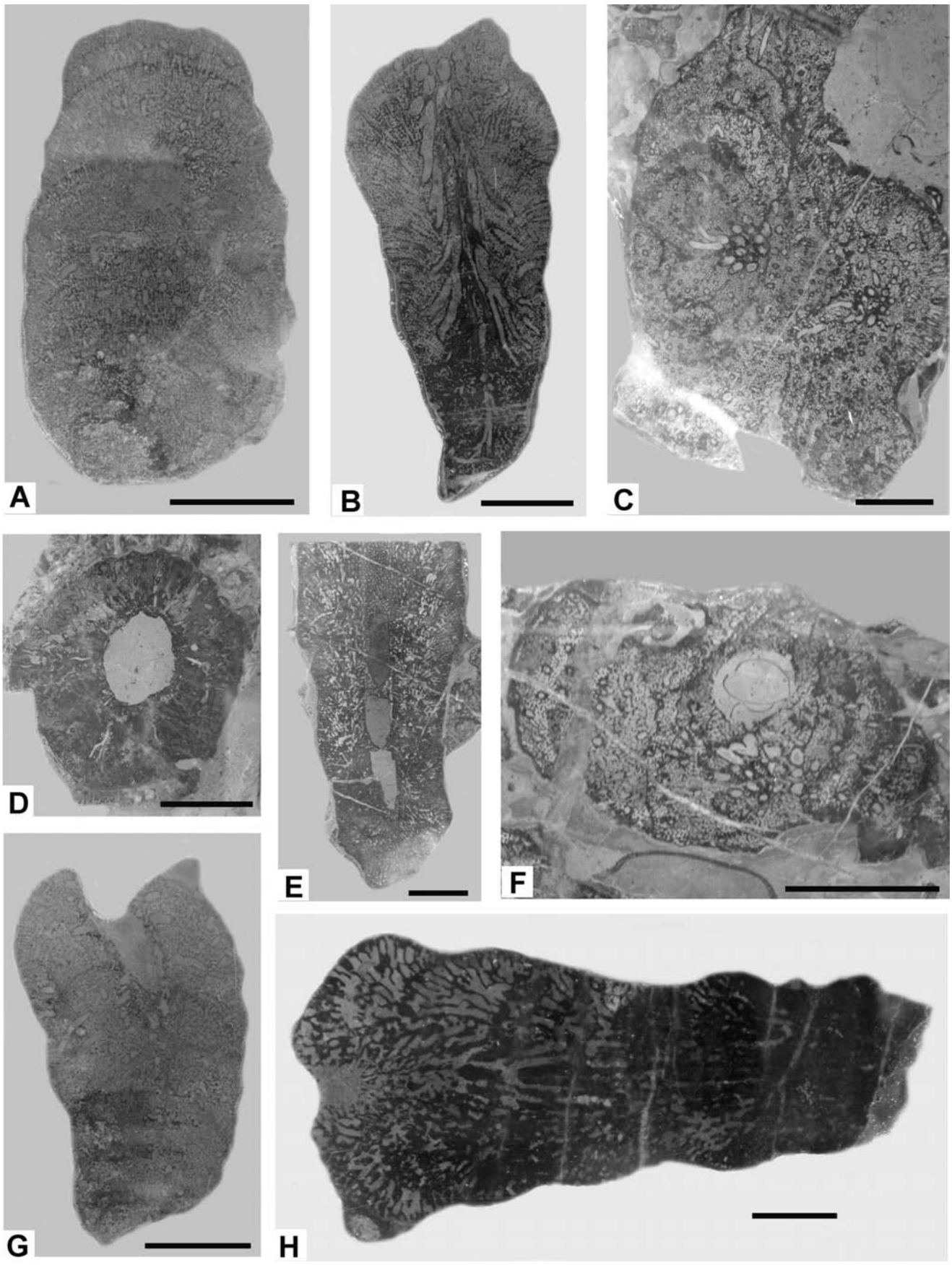
"Inozoans" from the small reef near the town of Yazd. Scale in all Fig. 10 mm.

Fig. A, D, G - *Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati. Fig. A - Marginally longitudinal section showing clearly the inhalant and exhalant canals. The spaces between these canals are filled with reticulate fiber skeleton. The spongocoel is cut marginally in the upper part of the section. Fig. D - Cross section of a specimen showing the radiating inhalant and exhalant canals. The diameter of spongocoel is nearly 1/3 of the sponge diameter. Fig. G - The oblique section shows the characteristics of the sponge like the one in Fig. A. The spongocoel is cut on the youngest part of the sponge.

Fig. B, C, F -? - *Sestrostomella robusta* Zittel. Fig. B - Longitudinal section through a specimen showing the axial canal bundle and the inhalant and exhalant canals ending to the axial canal bundle. The spaces between the canals in the sponge wall are filled by reticulate fiber skeleton. Fig. C - Section through two specimens growing together. The axially canal bundles are composed of about 10 individually canals. Some growing lines appear as thin and dark lines. Fig. F - Oblique section. Because the sponge surrounded another biogenic object, the canal bundle is in marginal position. The inhalant and exhalant canals, appearing as circles, are clearly recognizable.

Fig. E - *Preperonidella norica* (Senowbari-Daryan et al.). Longitudinal section through a specimen shows the upward running fibers skeleton of the sponge wall. Some cross elements were secreted within the axial canal. The upper part of the spongocoel is filled with secondary filling.

Fig. H - *Preperonidella* sp. Marginal longitudinal section through a specimen shows the fiber skeleton and the spaces between them diverging to the up- and outwards. The axially spongecoel is cut in the youngest part of the sponge (left in photograph).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Occurrence. *Preperonidella norica* is known from the Norian-Rhaetian reefs of the Nayband Formation in Iran (Senowbari-Daryan et al. 1997) and was described as *Radiofibra norica.* It also is known from the Norian reef limestone of Gosaukamm in Austria (Senowbari-Daryan 2009b).

Preperonidella sp.

Pl. 2, Fig. H

Material: One specimen only, cut in longitudinal section.

Description. The only one specimen of this sponge shows a thick wall around the narrow spongocoel. The sponge wall is occupied by a coarse fiber skeleton with tubular interfiber spaces. The tubes are branches running divergently up- and outward. Especially inhalant and exhalant canals lack.

Subfamily Permocorynellinae Rigby & Senowbari-Daryan, 1996

Genus *Permocorynella* Rigby & Senowbari-Daryan, 1996

Type species: *Corynella ovoidalis* Parona, 1933

Permocorynella maxima Senowbari-Daryan, Seyed-Emami & Aghanabati, 1997

Pl. 2, Fig. A, D, G

1982 *Corynella* sp. - Wurm, p. 217, pl. 35, fig. 1.

1997 *Permocorynella maxima* n. sp. - Senowbari-Daryan, Seyed-Emami & Aghanabati, p. 302; pl. 3, fig. 1-8; pl. 6, fig. 5; pl. 7, fig. 1-3, 6; text-fig. 7.

2009b *Permocorynella maxima* Senowbari-Daryan, Seyed-Emami & Aghanabati. - Senowbari-Daryan, p. 125; pl. 9, fig. E; pl. 12, fig. D-E; pl. 17, fig. A/1.

Material: Five specimens, three of them are illustrated in Pl. 2, Fig. A, D, G.

Description. The diameter of this cylindrical to conical sponge varies between 18 mm and 22 mm. The length of sponge is different and the true length can not be determined with any confidence. The thick sponge wall is pierced by inhalant and exhalant canals. The space between the canals is occupied by a reticulate fiber skeleton. A spongocoel with a diameter of about the wall thickness passes internally through the whole sponge. *Permocorynella maxima* is – in addition to *Sestrostomella* and *P. maxima* – the most abundant inozoan sponge in the reef investigated near the town of Yazd.

Occurrence. Like the previous species, *Permocorynella maxima* is known from the Norian-Rhaetian reefs of the Nayband Formation in Iran (Senowbari-Daryan et al. 1997, this paper) and from the Norian reefs of Gosaukamm of Austria (Senowbari-Daryan 2009b).

Family Sestrostomellidae de Laubenfels, 1955

Genus *Sestrostomella* Zittel, 1878

Type species: *Sestrostomella robusta* Zittel, 1878

?Sestrostomella robusta Zittel, 1878

Pl. 2, Fig. B-C, F

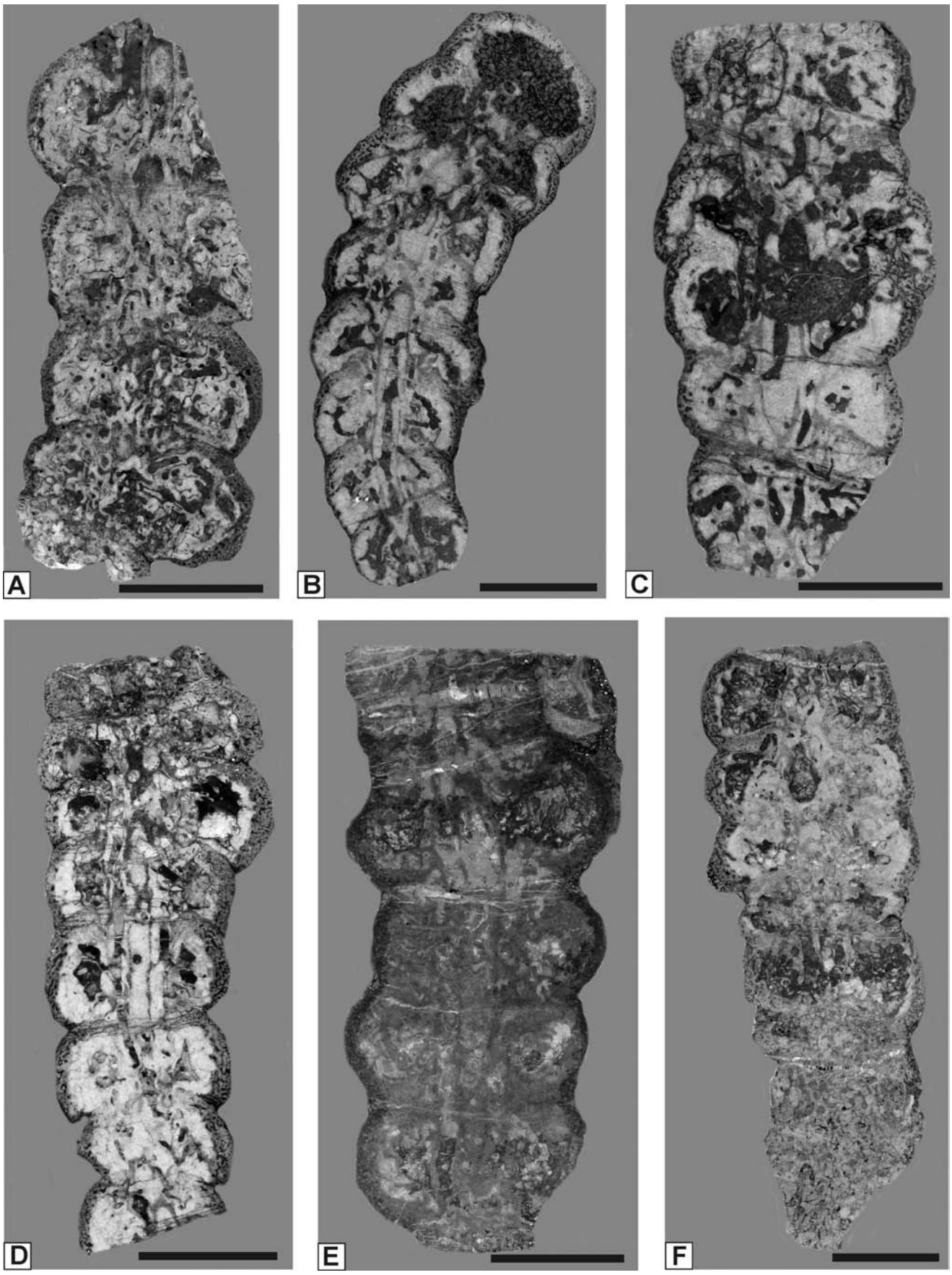
1997 ?*Sestrostomella robusta* Zittel - Senowbari-Daryan, Seyed-Emami & Aghanabati, p. 310; pl.4, Fig. 1-7; pl. 6, fig. 6; pl. 8, Fig. 6 (cum synonymy).

Material: 6 specimens. Three of them are illustrated in Pl. 2, Fig. B-C, F.

Description. Cylindrical to club-shaped, single or dichotomously branched specimens of this sponge reach diameters between 12 mm and 17 mm in the investigated material. Like the previous species, *Permocorynella maxima*, the thick sponge wall contains inhalant and exhalant canals, which are bent upwards in axial region. These tubes of exhalant canals are grouping into clusters running vertically and forming the axial canal bundle, which passes internally through the sponge (Pl. 2, Fig. B). The diameter of individual tubes in such a bundle is

PLATE 3

Fig. A-F - *Welteria lutensis* n. sp. from the small reef near the town of Yazd. Scale in all Fig. 5 mm.
Fig. A - The longitudinal section through a specimen shows four chambers. Chamber interiors are filled with secondary skeletons of type one and 2. Fig. B - The longitudinal section through a curved specimen shows clearly the internal segmentation and the outer annulation corresponding to the internal segmentation. The chamber walls are covered by white appearing secondary skeleton of type 2, which is much thicker in older chambers than in young chambers. One axial tube with thick wall is cut in the lower part. Fig. C - Longitudinal section through several chambers. Some chamber interiors are filled totally with secondary skeleton of type 2. The dark and "spongy" appearing chamber exowalls exhibits the mazelike pore system discussed in the text. The axial canal bundle is cut in middle region of the sponge. Fig. D - Longitudinal section showing the "spongy" chamber walls, axial canal system. Inside of the chamber walls is covered by the white appearing secondary filling skeleton (type 2). The old chambers are filled totally with such skeleton. Fig. E - Longitudinal section of a poorly preserved specimen showing the axial canal bundle. Fig. F - the longitudinal section through a poorly preserved specimen shows similar characteristics of the sponge like in Fig. E.


A
B
C
D
E
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the same and their number is about 10 (Pl. 2, Fig. C). The tubes communicate with the interfiber spaces of the chamber wall via small openings. The fiber skeleton between the inhalant and exhalant canals is of reticulate type.

Remarks. Detailed discussion about the possibly attribution of Iranian specimens to *Sestrostomella robusta* is given by Senowbari-Daryan et al. (1997). Further inozoan sponges with a canal bundle, like *Sestrostomella robusta*, are known as *Precorynella* Dieci, Antonacci & Zardini (1968) or *Stolanella* Bizzarini & Russo (1986). The morphological differences of the three genera are discussed by Bizzarini & Russo (1986). Spicules are not known from neither from *Precorynella* and *Stolanella* nor from Iranian specimens. According to Ziegler & Rietschel (1970) the spicular skeleton of *Sestrostomella* is composed of tripods. Reitner (1992) found in *Sestrostomella robusta* from the Carnian of Cassian Formation (Italy) two types of diactine spicules with different dimensions (100-225 µm and 50 µm). According to him *Sestrostomella robusta* is not a calcisponge, it could be a haplosclerid sponge type. Spicular skeleton is not known from Iranian species of *Sestrostomella*. Therefore the attribution of this species to *Sestrostomella* is uncertain.

Occurrence. ?*Sestrostomella robusta* is known also from the other Norian-Rhaetian reef localities in Iran (Senowbari-Daryan et al. 1997). *Sestrostomella robusta* is known also from the Carnian (Riedel & Senowbari-Daryan 1991). Sponges like the Iranian species also are described as *Sestrostomella robusta* by Senowbari-Daryan (2009b) from the Norian reef of Gosaukamm, Austria. The Norian-Rhaetian species from Iran and Austria could be the same as *S. robusta*, if the spicular skeleton is proven from these localities. Inozoan sponge like the Iranian species occurs also in Norian reefs of Taurus Mountains, south Turkey (unpublished material of the first author).

Family Auriculospongiidae Termier & Termier (in Termier et al. 1977)

Subfamily Auriculospongiinae Termier & Termier (in Termier et al. 1977)

Genus *Anguispongia* Senowbari-Daryan, 2005b

Type species: *Anguispontia parva* Senowbari-Daryan, 2005b.

Additional species: *Anguispongia magna* Senowbari-Daryan, 2005b.

Anguispongia parva Senowbari-Daryan, 2005b

Pl. 1, Fig. K

2005 *Anguispongia parva* nov. sp. - Senowbari-Daryan, p. 266; pl. 2, Fig. 1-6; pl. 3, fig. 1-3; text-fig. 6.

Material: One specimen is illustrated. Three specimens were observed in the field.

Description. Ear- or sheet-like curved or loopy-shaped sponge with pores on the outer surfaces. The skeletal fibers of the sponge interior appears variable in different position, either as parallel lines with interfiber tubes arranged vertically to the sheet surface or they appear honeycomb-like in direction parallel to the sheet surface. In oblique sections to the sheet surface the fiber skeleton appears as align parallel to the surface. The length of the sheets is variable, but the sheet thickness is less than 10 mm, usually about 5 mm. Detailed description of the species is given by Senowbari-Daryan (2005b).

Occurrence. *Anguispongia parva* occurs also in other reef localities in central and northeast Iran (Senowbari-Daryan 2005b).

Class **Hexactinellida** Schmidt, 1870

Order **Innaecoeliida** Boiko, 1990

Family Casearіidae Schrammen, 1937

Synonymy:
Inaecoeliidae Boiko, 1990.
Monilispongiidae Wu, 1990.
Dracolychniidae Wu, 1990.

Genus *Casearia* Quenstedt, 1858

Type species: *Casearia articulata* (Schmidel), 1780

Casearia sp.

Pl. 1, Fig. I

Material: Two incomplete specimens.

Description. Both specimens of *Casearia* are incomplete and were cut in oblique longitudinal sections. Both specimens have diameters of 30 mm. The sponge is composed of ring-shaped chambers arranged around the axial spongocoel of 16 mm in one specimen, 20 mm in the other one. Chamber height varies between 6.0 mm and 8.0 mm. Chamber walls are thin (0.2-0.4 mm) and are composed of hexactine with the same size forming the lattice. The chamber walls are pierced by pores of 0.3-0.4 mm in diameter. Pores are more abundant in exowalls than in inter- and endowalls. Chamber interiors were hollow and were subsequently filled later by micritic sediment.

Remarks. In contrast of hypercalcified sponges the hexactinellid sponges are very rare in Upper Triassic (Norian-Rhaetian) reef on the world in general and also in reefs and reefal constructions within the Nayband Formation in Iran. Senowbari-Daryan & Hamedani

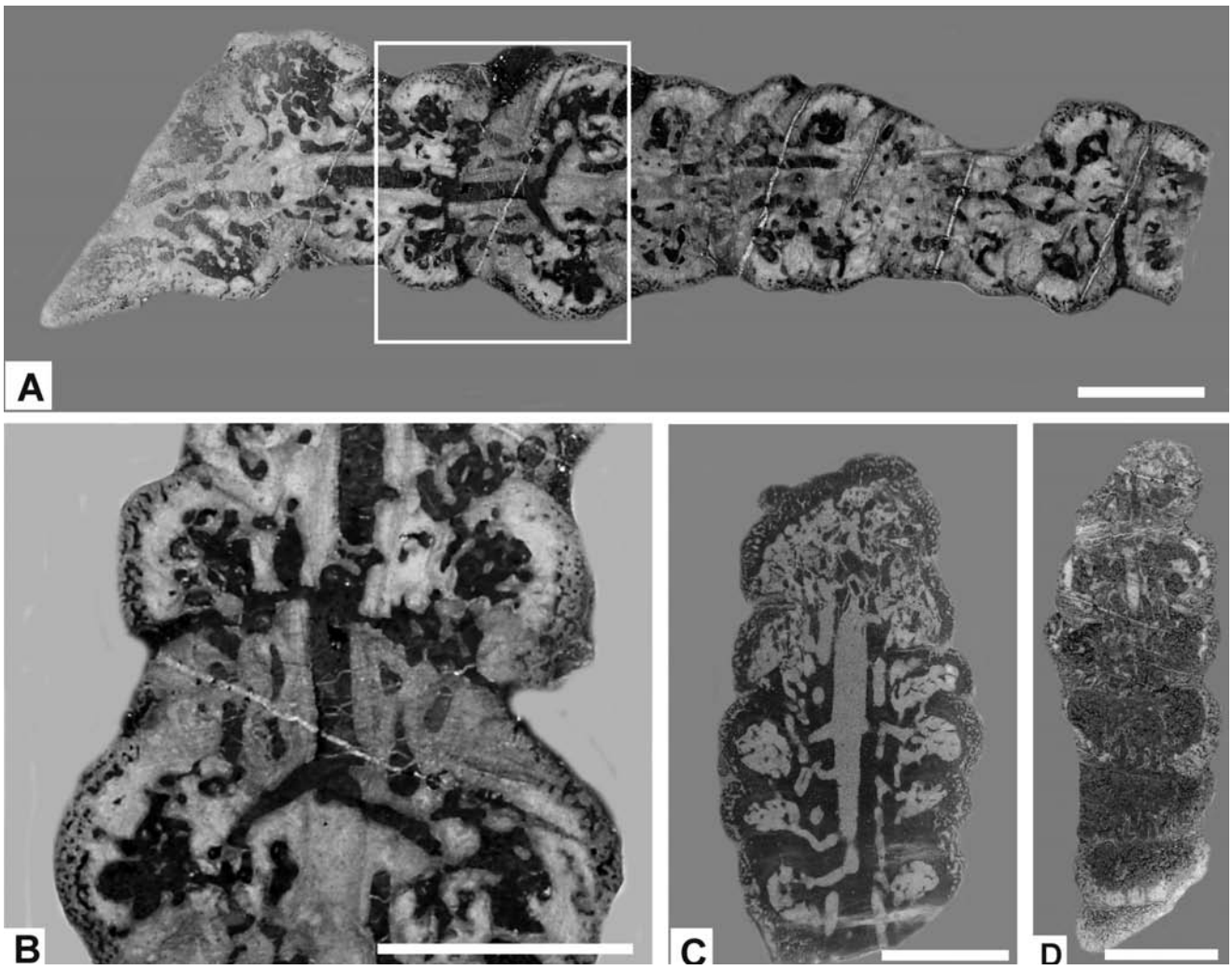

PLATE 4

Fig. A-D - *Welteria lutensis* n. sp. from the small reef near the town of Yazd. Scale in all Fig. 5 mm.
Fig. A - Holotype. Axially longitudinal sections exhibiting the canal bundle of spongocoel. The spongocoel walls contain only some openings. The spongy mazelike canal system of the exowalls is recognizable (for magnification see Fig. B). The inside of exowalls is covered by white appearing secondary skeleton of type 2. Fig. B - The enlargement of two chamber of holotype shows the mazelike canal system ("spongy" appearance) of the exowalls and several tubes as axial canal bundle. Fig. C - Polished slab of a specimen through the axially longitudinal section. The loose filling skeleton within the chamber interiors are clearly recognizable. The exowalls are internally covered by secondary skeleton (type 2), appearing dark in polished slab. Note the mazelike canal system ("spongy") of the chamber exowalls. Fig. D - Marginally axial longitudinal section showing the chamber roofs with large openings continue as tubes of axial spongocoel and the white and thin appearing secondary skeleton (type 2) covered internally the exowalls of only two chambers.

(1999) described the species *Casearia articulata* from the Nayband Formation near Wali Abad, SE Abadeh, central Iran. Chambered and non-chambered hexactinellid sponges are relatively abundant in reefs south of the town of Delijan, north of Esfahan (Senowbari-Daryan 2005a; Rigby & Senowbari-Daryan 2007). The description of the hexactinellids from this locality is in preparation by the first author.

Upper Triassic (Carnian) hexactinellid sponges seem to be relatively abundant than in Norian-Rhaetian and have been described from the Alps by Keupp et. al. (1989), and from China by Wendt et al. (1989), Wu (1989), Wu & Xiao (1989), and Rigby et al. (1998).

Discussion. The diversity and importance of hypercalcified sponges, in addition to scleractinian corals and other reef organisms, is high in Upper Triassic reefs of the Nayband Formation. They were discussed by Senowbari-Daryan (2005a). Almost all described sponges in this paper, belonging to Yazd block, are known from other Norian-Rhaetian reef localities of the Nayband Formation in northeast Iran (Tabas-block) and in central Iran. Only the new chambered species - *Welteria lutensis* – was unknown from other localities. The most abundant sponge species - *Iranothalamia incrustans* (Boiko) – from other reef localities in Iran (Senowbari-Daryan 2005a), Pamir Mountains (Boiko: in

Boiko et al. 1991) and in North America (Senowbari-Daryan & Stanley 1992), was absent in reef limestone of the Yazd block. Also *Nevadathalamia variabilis*, an abundant sponge in other world reef localities of Norian age, is very rare in Yazd block and was represented by only two specimens.

The occurrence of only two chambered hexactinellid species of the genus *Casearia* in this locality could indicate the possible presence of more individuals or even other species in Yazd block. This may be revealed by more intensive collection of the sponges. The occurrence of hexactinellid sponges in this reef could be indicates of somewhat deeper, shallow water depositional paleoenvironment. As in other reefs in central and northeast Iran, the "typically benthic reef foraminifera" are extremely rare in the reef biotopes investigated so far, but involutinid foraminifers associated with green algae (dasycladales) and echinoderms, shells of bivalves, rarely brachiopods, may occur relatively abundant in bedded limestone around the reef structures.

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