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NORIAN AMMONOIDS FROM THE NAYBAND FORMATION (IRAN) AND THEIR BEARING ON LATE TRIASSIC SEDIMENTARY AND GEODYNAMIC HISTORY OF THE IRAN PLATE

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Abstract. A Middle Norian (Alaunian 2) ammonoid assemblage from north of Esfahan (Central Iran) is described and chronostratigraphically evaluated. Formerly known as *Distichites* fauna, it represents a geographically widely distributed and stratigraphically important fossil level in the lower part of the Upper Triassic Nayband Formation. The new distichitid ammonoid genus *Mesodistichites* with the new species *M. evolutus* are introduced; additional faunal members are *Noridiscites nodosus* n. sp. and the leiostracean *Stenarcestes diogenis* and *Pinacoceras* cf. *imperator*.

The Nayband Formation of the Esfahan region, belonging to the Zefreh-Soh Facies, is lithostratigraphically emended to contain three formally introduced members (Parsefid, Venher and Niazmargh members), which are all of Norian age, whereas Rhaetian sediments are missing. These members are correlated with Norian lithostratigraphic units of the type sequence of the formation in Nayband, eastern Iran. Integration of all Iranian Nayband data allows the recognition of three 3rd order sequences within this formation and the proof of a major pre- or syn-Jurassic unconformity across Central Iran and the Central-East Iranian Microcontinent (CEIM) related to the Main-Cimmerian event. Because of the latter and of major lithostratigraphic and facial differences, we propose to exclude the Nayband Formation from the Shemshak Group. A careful review of the available biostratigraphic data from northern and southern Iran let us further assume that the collision of the Iran Plate with Eurasia occurred in the later Early Carnian and was concurrent to the onset of the Carnian Humid Episode.

Introduction

Following the early Late Triassic collision (Sengör 1990) and accretion of former Cimmerian blocks along the northeastern Tethys margin, Iran became a widespread uplift area with, by subsequent post-collisional extension, shallow marine and predominantly siliciclastic sedimentation (Fürsich et al. 2005). Dating of these early transgressive sediments is of specific importance for the timing of the post-collisional stratigraphic gaps and the onset of new sedimentary cycles - a difficult task in light of the poor record of time-diagnostic pelagic fossils from the mostly shallow-marine successions. Upper Triassic ammonoids are thus rather rare along the Asian Tethys margin except for Iran where two peculiar faunas, one of earliest Norian (= Ekrasar fauna: Seyed-Emami et al. 2009) and another of Middle Norian age [lower part of Nayband Fm.: Zahedi (1973) and lower part of Shemshak Group *sensu* Seyed-Emami & Wilmsen (2007)] occur. The latter is dominated

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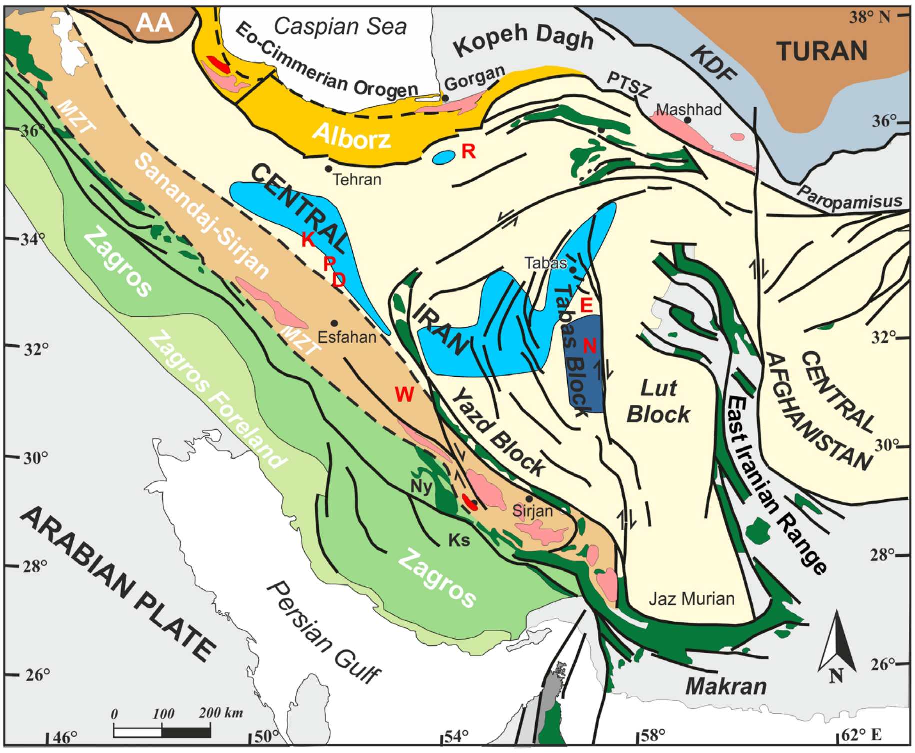


Fig. 1 - Structural model of Iran (from Zanchi et al. 2009b) with the position of the most important localities cited in the text, as well as of the two main facies of the Nayband Formation. Light blue: Zefreh-Soh Facies; blue: Nayband Facies (for explanation see text). D=Dizlu, E=Espahk, K=Kuh-e-Parsefid, N=Nayband, P=Panchar Mountain, R=Rezaabad, W=Waliabad.

by distichitids and therefore long known as *Distichites* fauna (Seyed-Emami 1975). A comprehensive summary of these faunas has been presented by Seyed-Emami (2003) who demonstrated a wide geographic extent of the *Distichites* fauna across Central Iran. The most recent record of it is reported in Seyed-Emami & Wilmsen (2007) from Rezaabad, a locality already described earlier by Alavi-Naini (1972). Here, (1) we revise the *Distichites* fauna on the basis of collections from the Soh region near Esfahan (Fig. 1); (2) we erect the new ammonoid genus *Mesodistichites* with a new species, a further new ceratitid species of the genus *Noridiscites*, and we describe additional leiostracean ammonoid taxa of the genera *Stenarcestes* and *Pinacoceras*; (3) we document their exact sequential position and age and

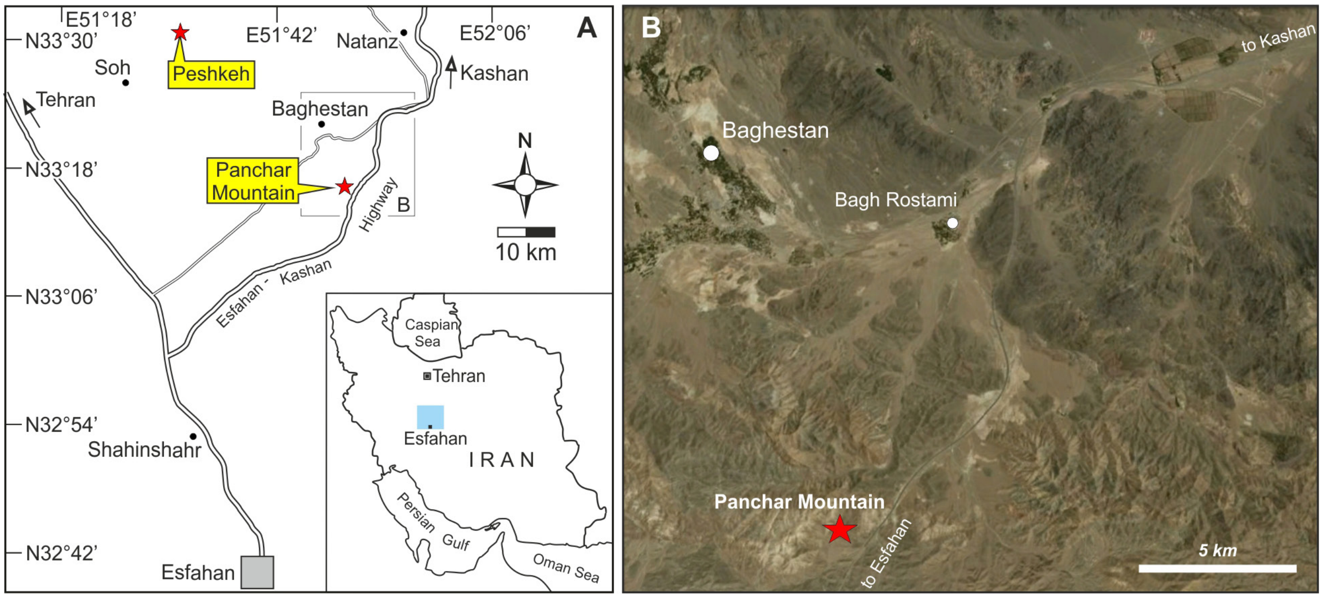


Fig. 2 - Location map of the fossil localties 1 and 2 (Panchar Mountain and Peshkeh). A) road map of the area; B) position of the Panchar Mountain where most of the ammonoids described in this work were collected.

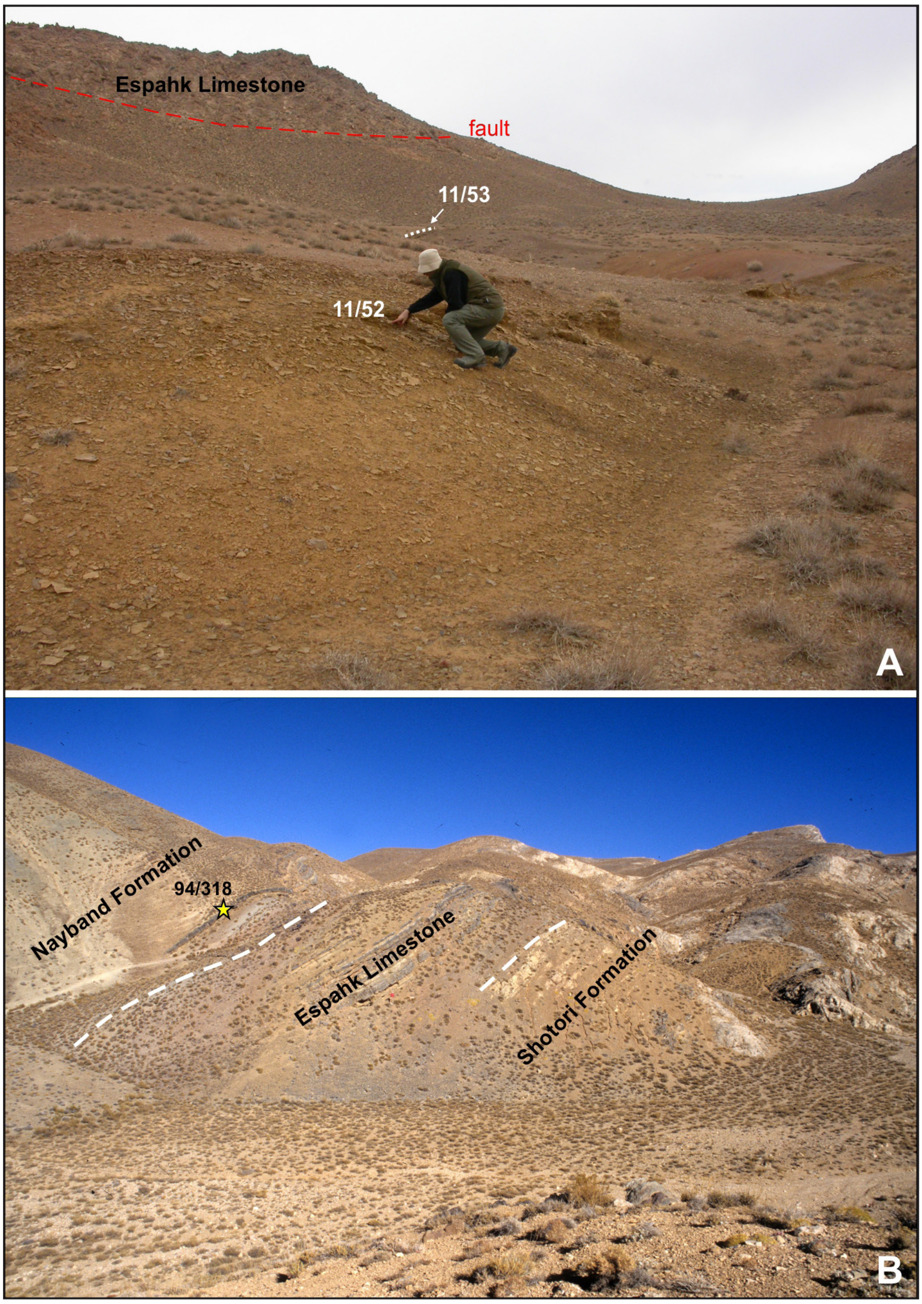


Fig. 3 - Field photoes of the studied localities. A) Panchar Mountain (fossil locality 1), with position of the two ammonoid-bearing beds; B) Peshkeh, (fossil locality 2), with position of the ammonoid sample 94/318.

(4) based on a revised Nayband biostratigraphy we discuss the Late Triassic sedimentary evolution of Central Iran s.l. (including the Central-East Iranian Microcontinent).

All described fossils were collected from the basal of the Nayband Formation north of Esfahan. A major part of these ammonoids has been recently collected by BSA at Panchar Mountain (fossil locality 1), some additional specimens result from an old collection of LK (1994) from Peshkeh, south of Kuh-e-Parsefid (fossil locality 2). Information on the repository of the collections are given in the Systematic Palaeontology chapter.

Stratigraphy and paleontology of the studied sections

The two fossil localities (Fig. 2, 3) occur along strike of the Nayband Formation between the Esfahan – Teheran motorway, 30 km south of Natanz (locality 1) and 40 km S of Parsefid Mountain (=Kuh-e-Parsefid, 3030 m; locality 2), about 40 km apart. Both localities show a thick oolite bed (~2 m) at the top of the underlying Espahk Limestone member, here interpreted as marker bed and as a possible isochronous correlation level in between them.

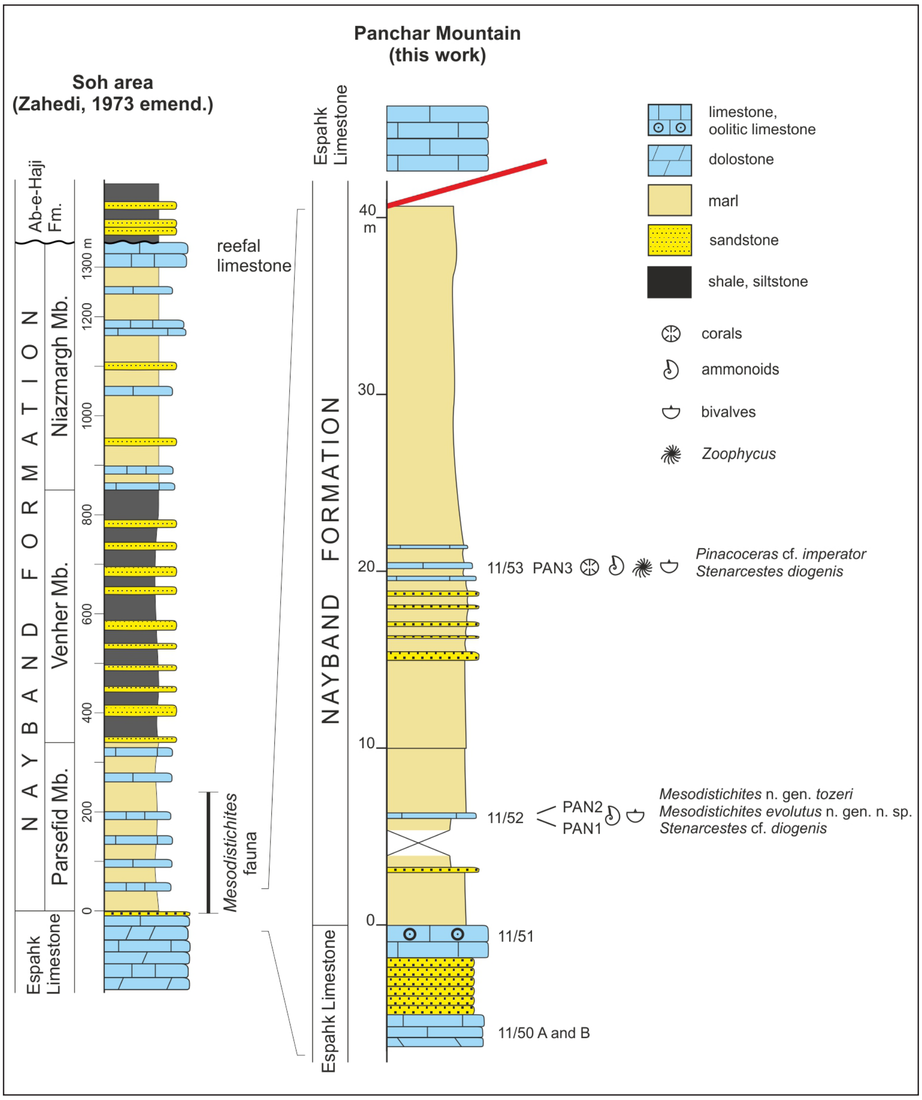


Fig. 4 - Stratigraphy of the Nayband Formation in the surroundings of Soh (from Zahedi 1973) (left) and (right) the Panchar Mountain stratigraphic section (fossil locality 1).

Fossil locality 1, Panchar Mountain, (coord. N 33° 16' 08.6"/ E 51° 50' 28.5") lies about 1 km W of the motorway 7 where an approximately 40 m thick part of the basal Nayband Formation is exposed (Fig. 4). The succession consists of marls with some sandstone layers and two intercalated units of marly limestone (samples 11/52 and 11/53; each <1 m thickness), 15 m apart. The upper of these marly and bivalve/gastropod-rich limestone units contains *Stenarcestes diogenis* (Mojsisovics, 1875) and *Pinacoceras* cf. *imperator* (Hauer, 1849) whereas the lower one bears *Mesodistichites evolutus* n. gen. n. sp., *Mesodistichites* n. gen. *tozeri* (Seyed-Emami, 1975) and *Stenarcestes* cf. *diogenis*, indicating an early Middle Norian age (Alaunian 2, *Himavatites hogarti* Zone of the Tethyan scale: Tatzreiter, 1981). From the upper interval are further bivalves (Hautmann et al. 2011) and gastropods (Nützel et al. 2012) reported. Both limestone beds also provided early Middle Norian platform conodonts of the genus *Epigondolella* which will be documented separately.

Fossil locality 1 is exactly the same site studied by Hautmann et al. (2011) and Nützel et al. (2012). However, some information on the locality given in these papers has to be corrected. The fossil locality is west of the Esfahan – Kashan/Teheran motorway, not east as reported by Hautmann et al. (2011: fig. 1) and by Nützel et al. (2012: fig. 1). Moreover, the thickness of 60 m for the Nayband Formation reported by Nützel et al. (2012: p. 54) has to be corrected to about 40 m, because the thick limestone interval at the top of the section (Fig. 4) is a repetition by fault of the stratigraphically underlying Espahk Limestone.

Intense block faulting and a very local lateral extent of the beds do not allow a complete thickness estimation of the Nayband Formation around locality 1. Though the contact to the underlying Espahk Limestone looks relatively sharp, a transition cannot be excluded because of an interlayered sandstone level in the upper part of the latter (Fig. 4). A transitional contact between the Espahk Limestone and Nayband Formation has also been assessed by Zahedi (1973, fig. 22) for the Kuh-e-Parsefid region, 40 km to the northwest.

Fossil locality 2 (coord. N 33° 31' 42.7"/ E 51° 31' 59.1") is named for Peshkeh, a tiny village and spring shown on the geological map 1:100,000, sheet Soh (Zahedi 1973). The locality lies 35 km NW of the Panchar Mountain outcrop, and 1 km N of the Peshkeh spring, and exposes rocks from the top of the Espakh Limestone to the basal Nayband Formation (Fig. 3). Ammonoids (*Mesodistichites evolutus* n. gen. n. sp., *Mesodistichites* n. gen. *tozeri*, *Noridiscites nodosus* n. sp., *Stenarcestes*, *Pinacoceras*) have been found in a 1m thick, shell-rich, marly limestone bed (sample 94/318, see Fig. 3B) approximately 5 m above the Espahk Limestone. The bed contains a rich bivalve assemblage (*Cassianella, Indopecten, Pinna, Umbrostrea, Homomya, Pleuromya, Costatoria)* and may correspond to the lower fossil bed (11/52) of the Panchar Mountain locality. Fossil locality 2 is in close neighborhood to the place where Zahedi (1973) has measured in detail the Upper Triassic succession of the region and defined his regional subdivisions of the Nayband Formation.

Nayband lithostratigraphy North of Esfahan

The Nayband Formation is known to vary between ~720 m (Fallahi 1980; Fallahi et al. 1983) and ~1400 m (Zahedi 1973; Seyed-Emami 2003) in thickness in the Zefreh-Soh (or wider Esfahan) area. At its type locality in Nayband, east-central Iran (Kluyver et al. 1983; Hautmann 2001; Fürsich et al. 2005), the formation has nearly the double thickness (3000 m), of which about half is made of a succession of Rhaetian age (Fig. 5). Erosion and thereby missing of sediments of Rhaetian age can explain the comparably reduced thickness in the wider Esfahan area.

A local subdivision of the Nayband Formation in the Esfahan area was proposed by Zahedi (1973; Figs. 4–5), with distinction of four informal members: "Schiste et calcaire de Parsefid", "Schiste et grès de Venher" and "Schiste et calcaires de Niazmargh". His basal "Serie de transition" (up to 70 m) consists of two different lithologies, a) a lower carbonate-rich part of coarse-grained limestone and dolomite beds (ca. 40 m) with siliciclastic interlayers, and b) an upper shale-rich interval with rare fine-grained, marly fossiliferous limestones that contain *Indopecten* and *Distichites*. The lower carbonate-dominated part (a) of Zahedi's "Serie de transition" is lithologically well comparable with the underlying Espahk Limestone as described from the Tabas Block of eastern Iran (Stöcklin et al. 1965), therefore it is here assigned to this unit. The close inter-connection with the Nayband Formation suggests a (Middle) Norian age for the unit, too. The older, Ladinian to Carnian age assignment of the Espahk Limestone reported by Brönnimann et al. (1974) for the Tabas region is no longer valid (see the discussion in the next chapter).

The upper terrigenous-rich and megafossil bearing interval (b) of Zahedi's "Serie de Transition" (p. 86: beds 21–22) is combined with the overlying "Schiste et calcaire de Parsefid" (up to 340 m), consisting similarly of dark and sandy shale with a few intercalations of marly to silty limestone and the same bivalves and ammonoids. The overlaying "Schiste et grès de Venher" (up to 510 m) represent unfossiliferous dark shales and grayish sandstones and are followed by the "Schiste et calcaires de Niazmargh" (up to 500 m), a thick grayish shale succession with limestone and sandstone intercalations containing corals, bivalves – including the stratigraphically important Upper Norian *Monotis salinaria* Bronn, 1830 – and the hydrozoan *Heterastridium*.

These three units are not only lithofacially well differentiated, but they are also mappable, based on their great thicknesses. Therefore we propose their emendation to the rank of formal members. The Nayband Formation of the so-called Zefreh-Soh Facies (Seyed-Emami 2003) thus is formed by the Parsefid, Venher and Niazmargh formal members, all of them of Norian age (Fig. 5). For the detailed lithologic description see Zahedi (1973): p. 87 and fig. 23 for the Parsefid Member; p. 98 and fig. 24 for the Venher Member; and p. 91 and fig. 25 for the Niazhmarg Member, respectively. Topographic location of the succession is marked on Zahedi's 1973 geological map and located 1.5 km to the south-southwest of Kuh-e-Parsefid (3030 m) in an altitude of ca. 2800 m (N 33°33'48.5, E 051°31'53.7). No fossiliferous Rhaetian sediments are known from the Zefreh-Soh area, where Jurassic sandstones of the former Shemshak Formation now called Ab-e- Haji Formation (Aghanabati 1977; Fürsich et al. 2005; Wilmsen et al. 2009c; Salehi et al. 2014, 2018a), or Cretaceous sediments, directly overlay the Upper Norian Niazmargh Member.

An apparently different stratigraphy is reported by Nützel et al. (2010) who described a Nayband-type sequence up to the Howz-e-Khan Member and without the Parsefid Member from Dizlu (locality also known as Bagher Abad), within the Zefreh-Soh area. However, the Parsefid Member is, though tectonically reduced, clearly present as proved by the record of *Distichites* reported from the same locality by Seyed-Emami (1975) and Kristan-Tollman et al. (1979: 135). Moreover, the presence of *Heterastridium* up to the topmost Nayband bed (Fallahi et al. 1983) also disproves the occurrence of any rocks younger than the Niazmargh Member at Dizlu. A similar misinterpretation is reported in Salehi et al. (2018b) who erroneously identified north of Dizlu in Kuh-e-Bejareh the Venher Member (= top of "T3" rock group in the respective geol. map of Zahedi 1973) as the Rhaetian Qadir Member.

Espahk Limestone

The lithological transition of the Espahk Limestone to the Nayband Formation implies an only slightly older age and therefore also a Norian age for this unit in the wider Esfahan area. The contact with the underlying Shotori Formation is, according to our own observations, clearly disconformable and may reflect a timely longer hiatus – and on a regional scale at least a paraconformity. This is in disagreement with the stratigraphic setting in the Nayband area, where opposing relationships between the three units are described, i.e. a gradual transition from the Shotori Formation to the Espakh Limestone and a hiatus and an emersion phase between the Espakh Limestone and the Nayband Formation (Seyed-Emami 2003).

The age of the Espahk Limestone is, however, highly disputed. Based on a probable Ladinian dating of its foraminifera fauna (Zaninetti & Brönnimann 1974) and an apparent stratigraphic conformity, Seyed-Emami (2003) and Fürsich et al. (2005) included the Espahk Limestone into the Shotori Formation as its upper member. Zaninetti & Brönnimann's (1974) faunal and bio-chronostratigraphical analises, however, have been highly criticized and rejected by Kristan-Tollmann et al. (1979) who, after a thorough revision of the foraminifera, concluded a Norian age for the Espakh Limestone at its type locality. A post-Carnian age is further indicated by the occurrence of large-sized (20 cm) megalodontids in the wider Nayband area (Seyed-Emami 2003), because Lower Carnian megalodontids are much smaller and do not exceed 10 cm in size (Vegh-Neubrandt 1982, fig. 10). On the other hand, small megalodontids and Carnian dasycladaceans (Senowbari-Daryan 2003) have been found in Nayband within the top-part of the Shotori Formation. These date the top of the Shotori Formation to the Early Carnian and prove a distinct Late Carnian to Early (?) Norian pre-Espahk sedimentary gap. The indicated late Early Carnian age of the Eo-Cimmerian phase allows us to link this event with the climatic perturbations of the timely corresponding onset of the Carnian Humid Episode (see Ruffel et al. 2015), which leads to widespread regressions, breakdown of the shallow water carbonate productivity and a change to siliciclastic-dominated sedimentation along the northern and western Tethys margin.

Correlation, age and sequence analysis of the Nayband Formation

Seyed-Emami (2003) informally distinguished, besides the main Nayband succession of Central Iran, two additional Nayband facies zones, the Zehfreh-Soh and the Abadeh facies. The latter is a synonym of the Waliabad facies of Kristan-Tollmann & al. (1979) and represents a succession of basal volcanoclastic sandstones overlain by fossil-rich uppermost Carnian to lowermost Norian mixed terrigeneous-calcareous beds, topped by a lower Norian reef limestone (Besse et al. 1998). The much older age, the contrasting lithology and a completely different fauna (e.g. Seyed-Emami 2003) lead us to separate this succession from the Nayband Formation in the type area. Regarding its palaeogeographic positon along the edge of Central Iran, it may be interpreted as a different transgressive succession deposited along the southern border of Iran during the early Late Triassic. The intra-Carnian sedimentary break on the Iran plate

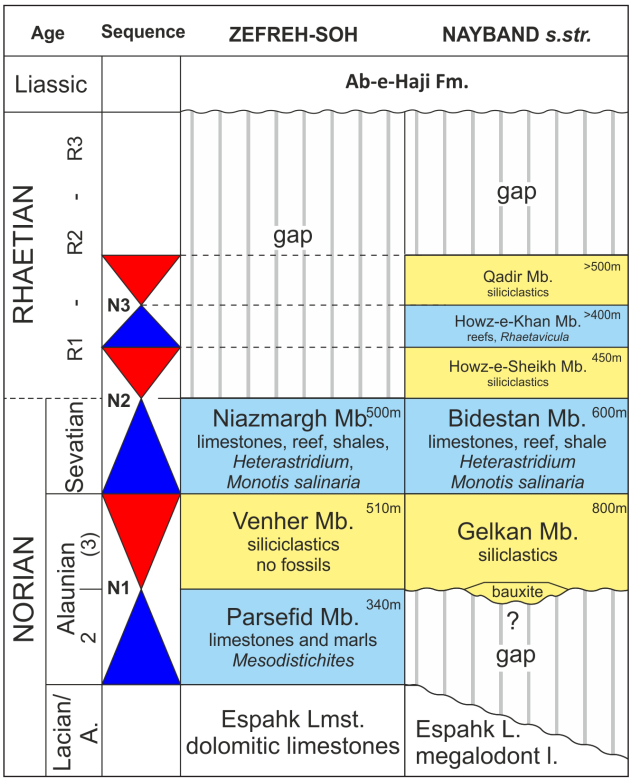


Fig. 5 - Norian to Rhaetian stratigraphy of the Soh and Nayband areas.

may have resulted from a preceding compressional event triggered by the southward jump of the subduction front from the closing Palaeotethys to the northern Neotethys margin in the course of the Eo-Cimmerian collision (Sengör 1990; Zanchi et al. 2009a; Wilmsen et al. 2009a).

Discrimination of the Zefreh-Soh succession as an informal facies of the Nayband Formation by Seyed-Emami (2003) seems not adequate regarding the regional extent of the two types of successions (Fig. 1). We favor an equal treatment of both the Zefreh-Soh and the Nayband s.s. facies as the former is known across a much wider area from northern and southern central Iran, whereas the latter is regionally restricted to the close surroundings of Nayband (Fig. 1, 5). The Nayband and Zefreh-Soh facies show in part comparable sequences of alternating, either carbonate-bearing, fossil-rich or predominantly siliciclastic, fossil-poor intervals which are named as individual members. Though certain members are directly correlatable between the regions by characteristic fossils (i.e. Niazmargh vs. Bidestan members), a uniform lithostratigraphy is seen as premature because of major differences in the stratigraphic ranges of the two successions. The Nayband Facies misses a counterpart of the Middle Norian fossil-rich and open-marine Parsefid Member of the Zefreh-Soh Facies. In Nayband, sedimentation starts according to Hautmann (2001) with the siliciclastic Gelkan Member erosionally overlying the Shotori Formation - and thus discordant - and with local bauxitic lenses (Seyed-Emami 2003) at the base (Fig. 5). The Nayband succession further shows at the top a nearly 1500 m thick Rhaetian succession represented by the Howz-e-Sheik, Howz-e-Khan and Qadir members (Hautmann 2001), which is otherwise completely missing in the Zefreh-Soh Facies, probably because of post-Norian erosion.

Dating of the basal Nayband Formation to the Middle Norian is well constrained for the Zefreh-Soh Facies by the long-known distichitid ammonoid fauna of the Parsefid Member. For Nayband, where this fauna is missing, an older, Early Norian age is proposed for the basal Gelkan Member by Cirilli et al. (2005) on a palynological base. Though the Gelkan Member cannot be dated directly by megafossils, we assume a late Middle Norian age for it too, on the basis of a lithostratigraphic comparison with the Venher Member of the Zefreh-Soh Facies (Fig. 5). This correlation is supported also by the late Norian age of the overlying Niazmargh and Bidestan members, based on the occurrence of the age-diagnostic bivalve *Monotis salinaria* and common large-sized *Heterastridium.* Palynological age assignment of the Howz-e-Sheik Member to the Rhaetian follows Cirilli et al. (2005), but is difficult to verify independently due to paucity of megafossils. Occurrence of *Rhaetavicula contorta* (Portlock, 1843) and absence of *Heterastridium,* otherwise, allow a safe dating of the major reef-bearing and fossil-rich Howz-e-Khan Member to the Rhaetian. As Hautmann (2001) reported a Triassic-type bivalve fauna with the presence of the genus *Indopecten* from the Qadir Member (there written as Kadir Mb.), a still relatively early Rhaetian age for the top of the Nayband Facies can be assumed.

Though the latest Triassic to/or earliest Jurassic erosional break is represented all over Central Iran, it cannot be timely well constrained due to paucity of fossils. Since erosion cuts in part down into basal Nayband strata (e.g., Rezaabad: Alavi-Naini, 1972), this tectonic phase may be responsible for the present-day rather reduced, isolated and disjoint distribution of the formation. The intense post-Nayband tectonic phase of Central Iran is timely mirrored in the Alborz by the "main uplift phase of the Cimmerian mountain chain" or "event 2" of Fürsich et al. (2009) or, the "Main Cimmerian unconformity" of Wilmsen et al. (2009a). In the Alborz, however, as shown in their fig. 17, the tectonic response and sedimentary breaks are apparently minor, leading Fürsich et al. (2009) to include the Nayband Formation into the Shemshak Group, without considering their different tectono-stratigraphic histories. We regard this approach as unsubstantiated and do not accept it because it leads 1) to a gross tectonic under-estimation of the more than regionally important post-Nayband phase (see also Wilmsen et al. 2009a,c; Salehi et al. 2018a) which is mirrored in and apparently linked to the concurrent Palaeotethys closure in the Karakorum (Gaetani et al. 2013) and in Tibet (Wang et al. 2018); and 2) to a putative identic sedimentary history of Central Iran and the Alborz during the Late Triassic though no single occurrence of Nayband rocks is known from the latter and despite the fact that the facies change between northern Central Iran and the Alborz is rather abrupt.

Wilmsen et al. (2009a) explain the "main Cimmerian unconformity" by the break-off of the subducting Palaeotethys slab around 200 myr. This is more than 30 myr after the first collision and considerably later than the model calculations by Hunen & Allen (2011) and the reconstruction given by Zanchi et al. (2009a; fig. 14). Wilmsen et al. (2009a) connect the slab break-off with a strong and rapid uplift phase in the Alborz which should have led there to major breaks in the sedimentary history. But sedimentary breaks are distinctly larger in Central Iran when compared to the Alborz, where Wilmsen et al. (2009a) and Fürsich et al. (2009) describe more or less complete sedimentary successions from the Triassic to the Jurassic. We think therefore that the connecting links in the Late Triassic geodynamic evolutionary model for the Iran plate proposed by Wilmsen et al. (2009) needs further investigations and it is not completely supported by data.

By integrating the main Nayband sequences of the Esfahan (Soh) and the Nayband areas in a synthetic log, a complete stratigraphic succession ranging from the Middle Norian to the early Rhaetian can be established for the formation (Fig. 5). The sequence analysis of the major facies differentiations allows the recognition of three distinct T-R cycles (3rd order sequences), whose transgressive system tracts are marked by carbonate-bearing, fossil-rich rocks and the regressive ones by fossil-poor siliciclastics. These sequences are from base to top of the formation termed as N 1 to N 3 (N for Nayband) and represent the following rocks and ages: N 1 contains the Parsefid Member (in Soh) as *transgressive system tract,* as well as the Venher Member (Soh) and Gelkan Member (Nayband) as *regressive system tract* of Middle Norian (Alaunian) age. N 2 is represented by the Niazhmarg Member (Soh) and Bidestan Member (Nayband) as *transgressive system tract*, and the Howz-e-Sheik Mb. (Nayband) as *regressive system tract* of Late Norian (Sevatian) to earliest Rhaetian age; and N 3 consists of the Howz-e-Khan Member as *transgressive system tract*, and the Qadir Member (both Nayband) as *regressive system tract* of early (?) Rhaetian age (Fig. 5).

The *Mesodistichites* n. gen. fauna of Iran

Composition

The Iranian *Mesodistichites* n. gen. association consists of 6 genera and less than 10 species, showing a modest diversity. Distichitids are the dominant constituent of this fauna, and show also the widest palaeobiogeographic distribution. The group is represented by a single new genus (*Mesodistichites* n. gen.) represented by two species. Accessory elements are a new ceratitid species of the genus *Noridiscites*, and leiostracean ammonoid taxa of the genera *Stenarcestes* and *Pinacoceras,* each represented by a single species. Rare tibetitids (*Tibetites* cf. *murchisonae*, *Anatibetites* sp.) have been described from several places (Rezaabat, Mahalat, Tafresh) in part with *Mesodistichites* n. gen. by Seyed-Emami (2003) and Seyed-Emami & Wilmsen (2007). Their partly fragmentary preservation and a missing documentation of the group-diagnostic suture line with median incised lateral saddle, however, makes the generic assignment doubtful.

Palaeoenvironment

The low diversity of the fauna may be explained as due to environmental factors. The wide and shallow shelf environment documented by the Parsefid Member, provided only occasionally relatively good living condition for open marine ammonoids.

Palaeobiogeography

Occurrence of Tibetitidae in Iran could be of biogeographic interest as the group is presently only known from the southern Tethys margin (Oman, Himalaya, Indonesia) where it forms a distinct Norian faunal element.

Age

Mesodistichites n. gen. differs from *Distichites* s.s. by the presence of a sub-rectangular cross-section, very low external keels and an external suture with small and only weakly incised saddles. Those features place *Mesodistichites* n. gen. close to *Ectolcites* and to the root of *Distichites*, and suggest an early Middle Norian age (*Himavatites watsoni* Zone, Alaunian 2) for both the *Mesodistichites* n. gen. fauna and the basal part of the Nayband Formation. Except for *Mesodistichites* n. gen. all other taxa are of minor stratigraphic value. *Noridiscites* may also be time-diagnostic but originally is described by Mojsisovics (1893) from an undifferentiated Middle Norian fauna in Hallstatt, Austria. If the Tibetitidae were identified correctly, they too would point to a Middle Norian age in general. Both the species of *Stenarcestes* and *Pinacoceras* have a long range from the Middle to Late Norian and are widespread within the Tethys.

Systematic Palaeontology

Material: All described fossils are stored in the Museo di Paleontologia, Dipartimento di Scienze della Terra, Milano University, Via Mangiagalli 34, Milano, Italy (MPUM). A major part of the ammonoids were collected by BSA at Panchar Mountain (fossil locality 1), while the remaining specimens were collected by LK in 1994 from Peshkeh (fossil locality 2).

Reference collections: The most important collections of tethyan distichitids, such as those studied by Mojsisovics (1893) and Tatzreiter (1981) are housed in the Sammlungen der Geologischen Bundesanstalt (GBA), Neulinggasse 38, Vienna, Austria.

Measurements: Acronyms: D = diameter (mm), H = whorl height D (mm) in D, U = umbilical diameter (mm) in D; W = whorl width (mm) in H.

Class **CEPHALOPODA** Linnaeus, 1758
Subclass **AMMONOIDEA** Dall, 1889
Order **Ceratitida** Hyatt, 1884
Superfamily Trachyceratoidea Haug, 1894
Family Distichitidae Diener, 1920

Genus *Mesodistichites* n. gen.
Type species: *Distichites tozeri* Seyed-Emami, 1975

Etymology: Combination of *meso* (Greek) = half and the genus name *Distichites*, referring to the close similarity with that genus.

Composition of the genus: *Distichites tozeri* Seyed-Emami, 1975, *Mesodistichites evolutus* n. gen. n. sp. and. *Mesodistichites* n. gen. sp. ind.

Diagnosis: A distichitid with comparatively thick, bituberculate coronate inner whorls that change in adult stage to an externally and laterally flattened body chamber with sub-rectangular cross-section. Coiling slightly involute or slightly evolute depending on the species. Ribs and tubercles resp. spines on outer shell layer are strong on the phragmocone but lose their strength in adult stage. Relative frequency of umbilical and ventrolateral nodes depending on the species. The ventral double keels are weakly developed and fade on the body chamber to end in a shallow sulcus. External suture line ammonitic, characterized by low, wide and only slightly incised lateral saddles.

Discussion. The most significant difference between the new genus *Mesodistichites* and *Distichites* Mojsisovics, 1893 is in the suture line (Fig. 6) that, in the new genus, is characterized by very wide and low saddles, with rounded general outline, and very short and single-pointed denticles (Fig. 6C-D). The saddles are much higher and narrower, nearly elongated, in *Distichites*, with a much more complex pattern on indentations (Fig. 6A-B), as very well shown by Tatzreiter (1981) in his revision of Distichitidae Diener, 1920 and of *Distichites* Mojsisovics, 1893.

In addition to the much more complex suture line, the larger specimens of *Distichites* retain a well-rounded cross-section, a prominent sculpture and stronger keels.

In the adult sculpture and suture line, otherwise, *Mesodistichites* n. gen. has much in common with the genus *Ectolcites* Mojsisovics, 1893, and the specific suture line has already convinced Tatzreiter (1981) to transfer *D. tozeri* to the genus *Ectolcites*. *Mesodistichites* n. gen. is here seen as a morphological intermediate between *Ectolcites* and *Distichites s. str.* and could be derived from an ectolcitid forerunner.

Paradistichites Diener, 1916 – of which *Pleurodistichites* Tozer, 1980 may be a younger synonym – has a similar suture line but well developed keels and a much weaker, more densely ribbed sculpture with only umbilical nodes and no tubercles or spines.

Occurrence. Middle Norian (Late Triassic) of Iran. The possible derivation from an ectolcitid forerunner would suggest a narrow interval for the range of *Mesodistichites*, limited to the early Middle Norian, i.e. the *Himavatites hogarti* Zone (Alaunian 2) sensu Tatzreiter (1981).

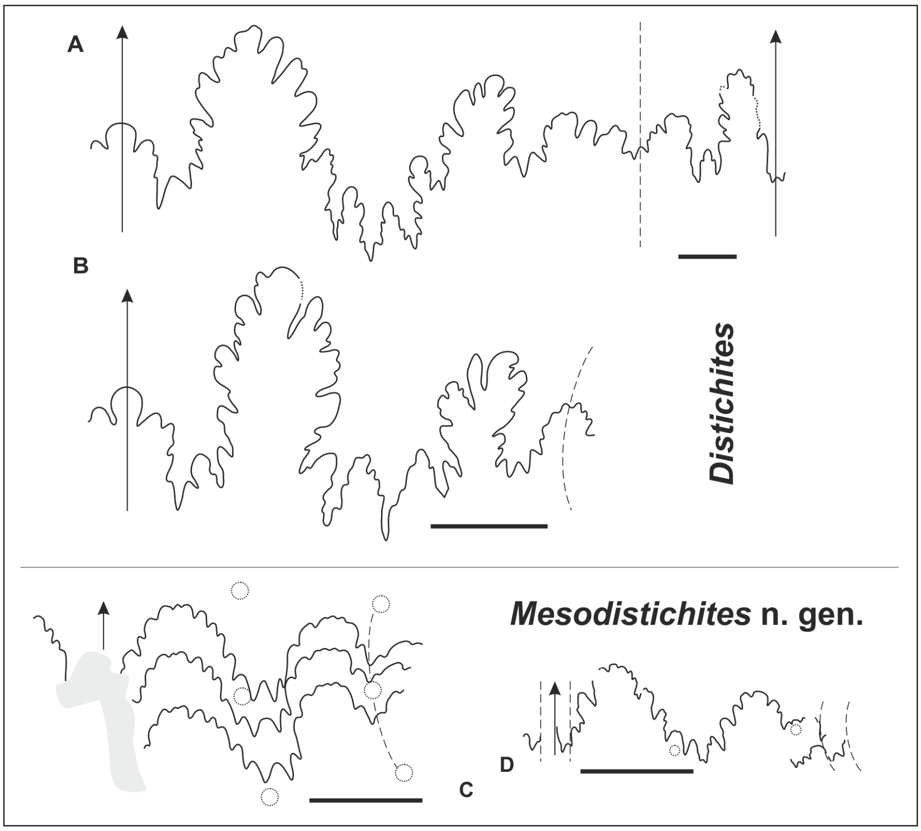


Fig. 6 - Suture lines of *Distichites megacanthus* Mojsisovics, 1893, type species of the genus *Distichites* Mojsisovics, 1893, and of *Mesodistichites* n. gen. *tozeri* (Seyed-Emami, 1975), type species of *Mesodistichites* n. gen. A) *Distichites megacanthus* Mojsisovics, 1893, specimen GBA 1980/10/68 (A16) at H=31 mm, from Timor (redrawn from Tatzreiter 1981, fig. 31a); B) same specimen, suture of inner whorls at H=15 mm (redrawn from Tatzreiter 1981, fig. 31b); C) *Mesodistichites tozeri* (Seyed-Emami, 1975), specimen MPUM 11816 (11/52.2-1); D) *Mesodistichites tozeri* (Seyed-Emami, 1975), specimen MPUM 11818 (11/52.2-4). Circles show the position of nodes; area covered by test is in gray. Bar scale is 5 mm, the suture D is mirrored.

Mesodistichites n. gen. ***tozeri*** (Seyed-Emami, 1975)

Pl. 1, figs 1a-c, 2a,b; Fig. 6C, D

1973 *Distichites* cf. *celticus* Mojs. – Zahedi, p. 95, fig. 26.
1975 *Distichites tozeri* n. sp. Seyed-Emami, p. 739, fig. 4, 6.
?non 1975 *Distichites tozeri* n. sp. Seyed-Emami, p. 739, fig. 5.
1980 *Ectolcites* cf. *tozeri* – Fallahi, p. 145, pl. 7, fig. 1-4.

Diagnosis: *Mesodistichites* with slightly involute coiling and slightly compressed whorl section. Venter of the inner whorls is usually strongly arched. It becomes less arched on the outer whorl, where the whorl section is subrectangular. The ratio of umbilical and ventrolateral nodes is about 2:3. Quite common occurrence of intercalatory ribs. Reduction of the sculpture on the outer whorl.

Material: Three specimens from Panchar Mountain: MPUM 11816 (11/52.2-1), MPUM 11817 (11/52.2-2) and MPUM 11818 (11/52.2-4). Two specimens from Peshkeh: MPUM 11819 (94/318.1) and MPUM 11820 (94/318.2).

Description. The available specimens fit quite well with the type specimens described by Seyed-Emami (1975). Their size is comprised between a diameter of 17 mm (MPUM 11818 [11/52.2-4]) and 47 mm (MPUM 11819 [94/318-1]).

Their coiling is slightly involute (H/U is always >1: Tab. 1), with thick but compressed whorl section and rounded, highly arched venter. The umbilical seam is located on the spiral line of ventrolateral nodes, but the arched venter of the last but one whorl is totally overlapped by the the outer whorl. On the body chamber of the larger specimens (MPUM 11816 [11/52.2-1] and MPUM 11817 [11/52.2-2]) the venter decreases and the whorl section becomes distinctly subrectangular. Ventral furrow bordered by two weak keels, not described by Seyed-Emami (1975), probably because of the relatively poor preservation of the venter of the holotype (e.g. fig. 4b). The weak keels are visible on the outer surface of the test, while they are not visible on the surface of the internal mold.

Ornamentation as described by Seyed-Emami (1975). The intercalatory ribs, bearing only the ventrolateral node, are relatively common, then the frequency of the umbilical nodes is notably lower with respect to that of the ventrolateral nodes (2:3 according to Seyed-Emami 1975: 740).The small specimen MPUM 11818 (11/52.2-4) (Pl. 1, fig. 1a) shows 6 umbilical nodes and 10 ventrolateral nodes in half a whorl at D=23.1 mm. The ratio is 4:7 in the larger specimen MPUM 11816 (11/52.2-1) (Pl. 1, fig. 2a), in the first quarter of the outer whorl (90°), starting from H=7 mm.

Ammonitic suture line exposed on two specimens (Fig. 6C, D). The saddles are broad and short, with a broad and an arched general outline. Indentations very simple.

Mesodistichites* n. gen. *tozeri	***D***	***H***	***W***	***U***	***H/W***	***U/D***	***H/U***
Holotype	45.0	18.0	13.5	14.85	1.333	0.33	1.21
Paratype *	28.0	11.2	11.2	9.52	1.0	0.34	1.176
MPUM 11819 (94/318-1)	47.3	20.2		14.8		0.312	1.364
MPUM 11817 (11/52.2-2)	45.6	16.2		*16.0*		0.350	1.012
MPUM 11816 (11/52.2-1)	44.5	16.2	14.5	15.5	1.117	0.348	1.045
same specimen	39.7	15.8	12.25	14.4	1.289	0.362	1.097
MPUM 11818 (11/52.2-4)	21.85	8.7	9.0	7.5	0.966	0.343	1.16
***Mesodistichites evolutus* n. gen. n. sp.**							
Holotype MPUM 11821 (94/318-3)	57.25	20.5	15.75	21	1.301	0.366	0.976
MPUM 11822 (94/318b)	69	*28*	-	29		0.420	0.965
MPUM 11826 (11/52.2-3)	26.8	8.3	*10.4*	11.0	0.798	0.410	0.754
MPUM 11824 (11/52.2-6)	20.5	6.8	9.25	8.65	0.735	0.421	0.786
MPUM 11823 (11/52.2-7)	18.6	6.65	*8*	7.5	0.831	0.403	0.886
MPUM 11825 (11/52.2-9)	11.65	3.95	5.8	4.2	0.681	0.360	0.940
***Mesodistichites* n. gen. sp. ind.**							
MPUM 11829 (11/52.2-5)	22.2	9.45	7.05	7.55	1.340	0.340	1.251

Tab. 1 - Dimensions (in mm) of *Mesodistichites* n. gen. The measurements of the type specimens of *Mesodistichites* n. gen. *tozeri* (Seyed-Emami, 1975) have been taken from the original publication. Asterisk for the paratype in open position (see text). Italic for measurements with low precision.

Dimensions. See Tab. 1.

Discussion. The type species of the genus differs from the below described *M. evolutus* n. sp. by the narrower umbilicus and the slightly involute coiling, the significant difference is documented by Tab. 1. The adult sculpture shows a reduction, while this reduction does not occur in *M. evolutus* n. sp.

The paratype of *M. tozeri* illustrated by Seyed-Emami (1975) as fig. 5a-b is left in a doubtful position because of its evolute coiling and strong ornamentation, contrasting with the features of the other type specimens. It might belong to *M. evolutus* n. sp., but it is left in open nomenclature because of the lack of oral view.

Occurrence. Middle Norian (Late Triassic) of Iran.

Mesodistichites evolutus n. gen. n. sp.

Pl. 1, fig. 3, 4a-c, 5a,b, 6a,b, 8a,b

? 1973 *Distichites iranensis* n. sp. Zahedi, fig. 25. *Nom. nud.*
?non 1975 *Distichites tozeri* n. sp. Seyed-Emami, p. 739, fig. 5.
2007 *Distichites* cf. *megacanthus* Mojsisovics, 1893 – Seyed-Emami & Wilmsen, p. 178, text-fig. 2A–C, E.

Etymology: The species is named for the all-time wide umbilicus.

Material: The type series consists of six specimens. Holotype MPUM 11821 (94/318-3) from Peshkeh. Five paratypes: MPUM 11822 (94/318b) from Peshkeh; MPUM 11823 (11/52.2-7), MPUM 11824 (11/52.2-6), MPUM 11825 (11/52.2-9), MPUM 11826 (11/52.2-3), all from Panchar Mountain. Two specimens are attributed to the new species but are not included in the type series: MPUM 11727 (11/52.2-8) and MPUM 11828 (11/52.1-4).

Diagnosis: *Mesodistichites* with evolute coiling, weakly arched venter, depressed inner whorls and strong ornamentation persisting on the body chamber. The ratio umbilical/ventrolateral nodes is about n:(n+1). Rare occurrence of intercalatory ribs.

Description. Five type specimens out of six are preserved in 3D, while the MPUM 11822 (94/318b) is in part deformed by sediment compaction. These specimens document the ontogeny from a juvenile stage (MPUM 11825 [11/52.2-9], with D of 8.3 mm; Pl. 1, Fig. 8a,b) to large size (holotype MPUM 11821 [94/318-3], with D about 56 mm and MPUM 11822 [94/318b]; Pl. 1, Fig. 5a,b, 6).

Coiling of the inner whorls is slightly evolute (H/U is always <0.97) and whorl section is slightly depressed (H/W=0.68–0.83: Tab. 1), with weakly arched venter. Due to the weakly arched venter, the whorl section looks subrectangular. During ontogeny, U/H is always <1, but the whorl section becomes compressed (see the holotype) . The umbilical seam is usually located on the spiral line of the ventrolateral nodes, in a way that these nodes are not covered by the last volution.

The umbilical nodes appear at a diameter of about 9 mm (H about 3.2 mm: Pl. 1, Fig. 8a-b), while the ventrolateral nodes already occur in the previous 2 volutions (720°: Pl. 1, Fig. 8b). The number of ventrolateral nodes increases during the ontogeny and slightly exceeds the number of umbilical ones. The juvenile specimens show 4 to 5 umbilical nodes and 5 to 6 ventrolateral nodes in 90° of coiling, while the holotype, an adult specimen, shows about 6 umbilical and 7 ventrolateral nodes. The second adult specimen (MPUM 11822 [94/318b]) is in the same line with the holotype, showing 6 umbilical for 8 ventrolateral nodes in a quarter of whorl.

Ribs are mostly primary and prorsiradiate, from nearly straight to slightly sinuous. Every primary rib bears one umbilical and one ventrolateral node, while intercalatory ribs, that start very low on the flank, bear only a ventrolateral node. The rare occurrence of intercalatory ribs explains the low ratio umbilical/ventrolateral nodes (about n/n+1).

All the ribs seem to end at the ventrolateral node, but actually they all divide at this position. This branching, well developed in *Distichites*, is barely visible because the ribs become extremely weak on the venter.

Suture line is not known because the type specimens are preserved with test.

Dimensions. See Tab. 1.

Discussion. The new species is assigned to *Mesodistichites* n. gen. on grounds of the similarity in general shell morphology, particularly the rectangular whorl section, the low keels and the less individualized suture line, features missing in all known species of the genus *Distichites*. It differs from *M. tozeri,* presently the only other species of the genus, by the wider umbilicus (Tab. 1), by the coarser body chamber ornamentation with still strong nodes, and by the broader and subquadrate whorls in early to middle growth stages.

Seyed-Emami & Wilmsen (2007, p. 179) point out a greater sculptural similiarity of inner whorls between their *Distichites* cf. *megacanthus* (now *M. evolutus*) and *D. tozeri* Seyed-Emami, 1975 (now *M. tozeri*) and hypothesized a possible sexual dimorphism between the two taxa. Due to the limited number of specimens available, we cannot test this hypothesis, as well as the status of *Mesodistichites* sp. ind., the third taxon presently assigned to the new genus *Mesodistichites*.

With regard to "*Distichites iranensis* n. sp." of Zahedi (1973), this taxon has never been described and the repository of the specimen figured by Zahedi (1973, fig. 25) is unknown. This specimen shows a strong ornamentation, consistent with the ornamentation of *M. evolutus*. Comparison of U with H suggests a ratio close to 1 (e.g., between evolute and involute coiling). However, the only figure available (lateral view) does not allow to understand wether the specimen is deformed by compaction, and does not allow the examination of the whorl section. Therefore, we regard Zahedi's taxon as a *nomen nudum*.

Occurrence. Middle Norian (Late Triassic) of Iran.

Mesodistichites n. gen. sp. ind.

Pl.1, fig. 7a-c

Material: Specimen MPUM 11829 (11/52.2-5), from Panchar Mountain.

Description. The specimen is of small size and well preserved in 3D. It exhibits slightly evolute and nearly depressed inner whorls (Pl. 1, Fig. 7a-c). The cross-section becomes compressed (H/W=1.33) with elevated venter at a whorl height of about 9 mm.

The umbilical nodes appear at about 2.6 mm of H (Pl. 1, Fig. 7c), while the ventrolateral nodes already occur on the previous 360° of coiling. Ribs are closely spaced, with about 7 ribs in 90° on the outer preserved whorl.

Remarks. The specimen differs from *M. tozeri* and *M. evolutus* n. gen. n. sp. of the same size by its compressed whorl section and relative dense ribbing. The innermost whorls are very similar to those of *M. evolutus* n. sp., but no comparison is possible with *M. tozeri*, because in this species this stage of growth is not known. The specimen MPUM 11829 (11/52.2-5) might belong to a new species, but due to the lack of individuals of larger size we prefer to keep it in open nomenclature.

Occurrence. Middle Norian of Iran.

Family Noridiscitidae Spath, 1951

Genus *Noridiscites* Spath, 1951

Type species: *Ceratites viator* Mojsisovics, 1893

Remarks. *Noridiscites* is a somewhat enigmatic genus that was introduced by Spath (1951) on the basis of a single species (*Ceratites viator* Mojsovics, 1893), in turn based on a single specimen. In order to accommodate his new genus, Spath erected a new, monotypic family. Since Mojsisovics and Spath, no specimens have been attributed to *Noridiscites* or to its type species. The family, however, has been accepted by Arkell et al. (1957) and Tozer (1981). The type species *C. viator* was collected from pelagic carbonate facies of undifferentiated Middle Norian age of Hallstatt (Austria).

The second genus thus far assigned to Noridiscitidae is *Nairites*, described by Kiparisova & Azarian (1963) from Nayband-type Norian strata in Armenia (locality Djermanis, E of Vedi). This genus was based on two new species *N. armenius* and *N. laevis*, which actually may be conspefic. *Nairites*, confirmed by Shevyrev (1968: p. 61) and Tozer (1981) to belong to the Noridiscitidae, looks generically close to *Noridiscites* and differs only in its sharper, keel-like external ridges and a narrow umbilicus (Shevyrev 1968).

Noridiscites nodosus n. sp.

Pl. 1, fig. 9a,b

Etymology: The name emphasizes the ornamentation by nodes.

Type specimen: A single, probably adult specimen, holotype by monotypy MPUM 11830 (94/318-4) from Peshkeh.

Diagnosis: *Noridiscites* with moderately open umbilicus and, compared to the type species, strong sigmoid ribs and two rows of very tiny nodes on the flank. The first row is located very low on the flank, very close to the umbilical margin, the second row is very close to the ventrolateral shoulder.

Description. The type specimen is preserved with test, and it is slightly crushed, probably by sediment compaction. The coiling is slightly involute and the whorl section, although slightly crushed, is subrectengular. The ventrolateral shoulder is subangular and the ventral side is flat and does not show any evidence of furrows or keels.

The ornamentation is well visible on the outer whorl, and consists of weak sigmoidal ribs and two rows of nodes, one on the shoulder and one very low on the flank, very close to the umbilical margin. The ventrolateral nodes are not visible on the inner whorls because the outer whorl is notably overlapping the last but one whorl. On the last quarter of whorl (see Pl. 1, Fig. 9a), the ratio lateral/ventrolateral nodes is 8/11.

The sigmoidal ribs start at the umbilical margin, where they are narrow and relatively well sculptured. During their course on the flank they become gradually wider and weaker, in a way that they seem to fade before the ventrolateral node.

The suture line is not exposed.

Dimensions (mm)

	D	H	W	U	H/W	U/D	H/U
Holotype MPUM 11830 (94/318-4)	45	17	-	15.25	-	0.338	1.114

Discussion. The new species agrees with *N. viator* in the flat and high flanks, a flat-topped venter and rectangular cross-section which is, close to the aperture, still undistorted preserved. Also similar are the sigmoid ribbing and the two rows of nodes. *N. nodosus*, however, differs from the nominate species in the stronger sculpture consisting of blunt sigmoid ribs with faint parallel growth lines and in the position of the two rows of tiny of nodes. In *N. viator* (e.g. Mojsisovics, 1893, pl. 142, fig. 2a), the two rows of extremely weak nodes are not on the flank, but they are located exactly on the umbilical margin and on the ventrolateral shoulder.

Age. The type of the genus has been described from Austria where it occurs in a Middle Norian (Alaunian) condensed fauna (Schlager et al. 1971). From the new finding it may be inferred that the genus is characteristic for the *H. watsoni* Zone or Alaunian 2.

Superfamily Arcestoidea Mojsisovics, 1875
Family Arcestidae Mojsisovics, 1875
Genus *Stenarcestes* Mojsisovics 1895
Type species: *Ammonites subumbilicatus* Hauer, 1846

Stenarcestes diogenis (Mojsisovics, 1875)

Pl. 1, fig. 10, 11a,b (both cf.); Fig. 7

1875 *Arcestes Diogenis* E. v. Mojsisovics pl. 67, fig. 4, pl. 68, figs1–3.
1902 *Stenarcestes Diogenis* – Mojsisovics, p. 271.

Material: Two undistorted phragmocone fragments with suture line from Panchar Mountain, level 11/53: MPUM 11831 (11/53.3-1) and MPUM 11832 (11/53.3-2). Three complete but diagenetically flattened specimens from the level 11/52 of the same section are attributed to the species but with cf.: MPUM 11833 (11/52.1-1), MPUM 11834 (11/52.1-3) and MPUM 11835 (11/52.1-2).

Description. The two fragmentary specimens from the upper level (11/53) at Panchar Mountain are preserved in 3D, therefore exhibit the original cross-section. The suture line of the specimen MPUM 11831 (11/53.3-1) is cone-in-cone (Fig. 7).

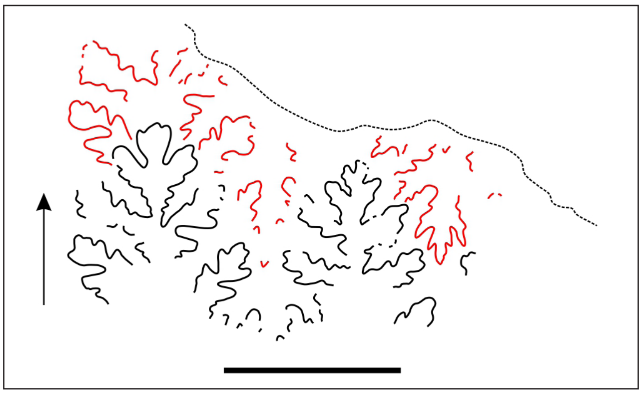


Fig. 7 - Suture lines of *Stenarcestes diogenis*, MPUM 11831 (11/53.3-1). Saddles and lobes are cone-in-cone. Bar scale is 5 mm.

The three *Stenarcestes* from the lower ammonoid level (11/52) are all flattened. The test of two of these specimens has been lost during preparation and on the internal mold up to four radial constrictions can be recognized.

Remarks. Arcestids of the genus *Stenarcestes* are characterized by all-time closed umbilicus and constrictions restricted to the internal mold and thus not visible when the test is preserved. Another key feature of the genus is the narrow spacing of the chambers which leads to a distinct "cone-in-cone" structure of the external suture line. Both features are well visible with the described specimens.

Occurrence. Middle Norian (Late Triassic) of Iran. The species is a common member of pelagic Middle Norian ammonoid faunas throughout the Tethys where it has been found in the Hallstatt facies of Austria, Oman and Timor, Indonesia (Mojsisovics 1893; Arthaber 1926 and pers. observ. LK). Its occurrence in a relatively shallow water environment seems a rare exception.

Superfamily Pinacoceratoidea Mojsisovics, 1879
Family Pinacoceratidae Mojsisovics, 1873
Genus *Pinacoceras* Mojsisovics, 1873
Type species: *Ammonites metternichi* Hauer, 1846

***Pinacoceras* cf. *imperator* (Hauer, 1849)**

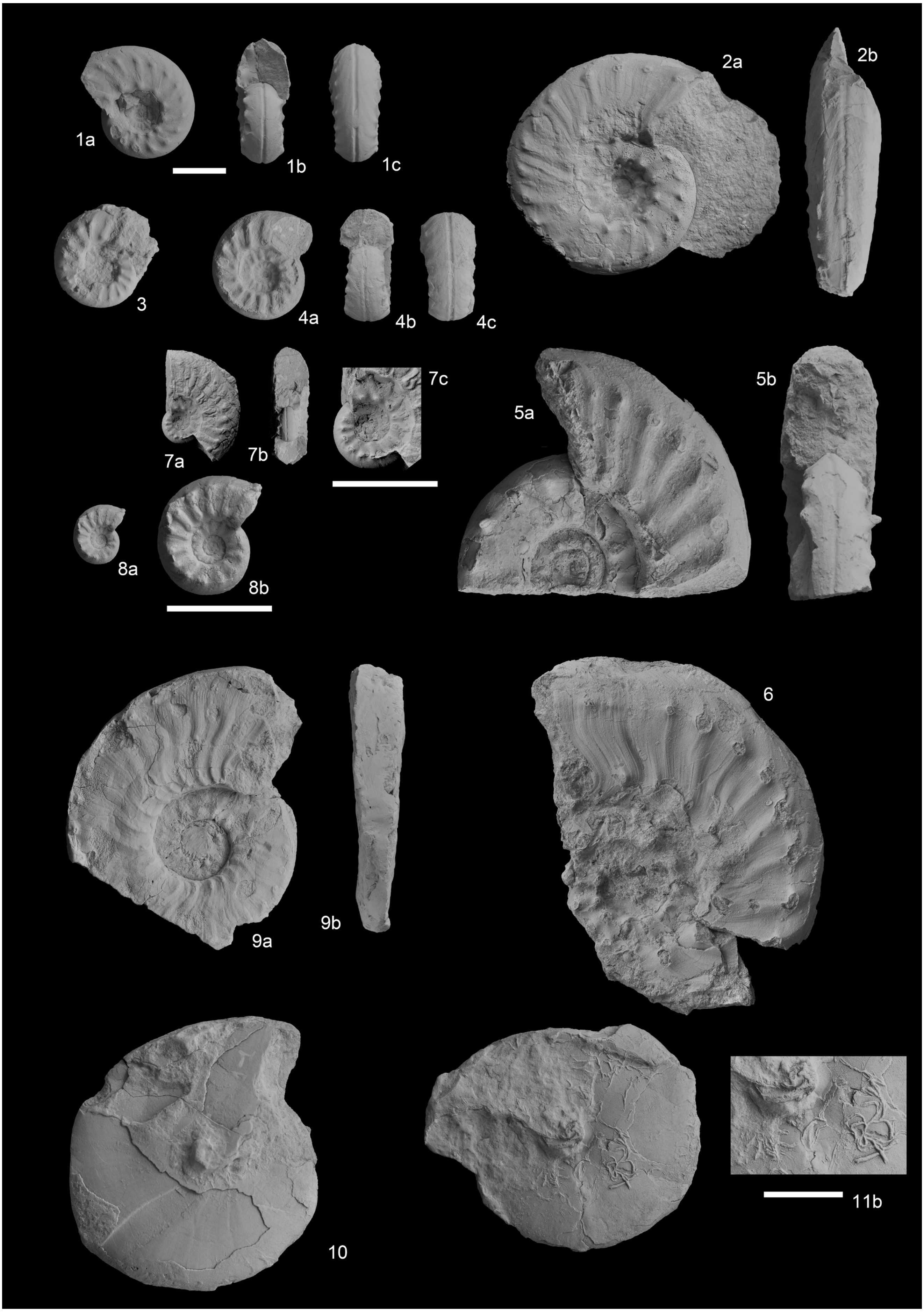
Material: One specimen MPUM 11836 (11/53.1-1) from Panchar Mountain.

Remarks. The specimen consists of a ca. 30° wide whorl fragment of a slim and high, oxycone phragmocone whose full size may have been around 250 mm in diameter. Distinct features for the identification as *Pinacoceras* are the well visible, highly intended suture line with several large bipartite and deeply incised lateral saddles and 6 serially arranged, bipartite incised auxiliary saddles. The specific approximation is based on the comparably wide-open umbilicus which is bordered to the flank by a short vertical wall. Though this combination of features fits for Norian pinacoceratids only with *P. imperator*, the fragmentary preservation precludes a formal specific identification.

Occurrence. Middle Norian (Late Triassic) of Iran. *Pinacoceras imperator* is a member of pelagic Middle and Late Norian ammonoid faunas throughout the Tethys and is common in the Hallstatt facies of Austria and Timor, Indonesia (Mojsisovics 1902; Arthaber 1926 and pers. observ. LK), but known from hemipelagic rocks of the Himalaya (Mojsisovics 1896; Diener 1906), too. Its occurrence in shallow water sediments is unusual.

PLATE 1

Fig. 1 - *Mesodistichites* n. gen. *tozeri* (Seyed-Emami, 1975), specimen MPUM 11818 (11/52.2-4) from Panchar Mountain, a) lateral view, b) oral view, c) ventral view.
Fig. 2 - *Mesodistichites* n. gen. *tozeri* (Seyed-Emami, 1975), specimen MPUM 11816 (11/52.2-1) from Panchar Mountain, a) lateral view, b) ventral view.
Fig. 3 - *Mesodistichites evolutus* n. gen. n. sp., paratype, specimen MPUM 11823 (11/52.2-7) from Panchar Mountain, lateral view.
Fig. 4 - *Mesodistichites evolutus* n. gen. n. sp., paratype, specimen MPUM 11824 (11/52.2-6) from Panchar Mountain, a) lateral view, b) oral view, c) ventral view.
Fig. 5 - *Mesodistichites evolutus* n. gen. n. sp., holotype, specimen MPUM 11821 (94/318-3) from Peshkeh, a) lateral view, b) oral view.
Fig. 6 - *Mesodistichites evolutus* n. gen. n. sp., paratype, specimen MPUM 11822 (94/318b) from Peshkeh, lateral view of the specimen that is quite flattened.
Fig. 7 - *Mesodistichites* n. gen. sp. ind., specimen MPUM 11829 (11/52.2-5) from Panchar Mountain, a) lateral view, b) oral view, c) enlarged lateral view showing the appearance of the umbilical nodes.
Fig. 8 - *Mesodistichites evolutus* n. gen. n. sp., paratype, specimen MPUM 11825 (11/52.2-9) from Panchar Mountain, a) lateral view, b) enlarged view showing the appearance of the umbilical nodes.
Fig. 9 - *Noridiscites nodosus* n. sp., holotype, specimen MPUM 11830 (94/318-4) from Peshkeh, a) lateral view, b) ventral view.
Fig. 10 - *Stenarcestes* cf. *diogenis* (Mojsisovics, 1875), specimen MPUM 11833 (11/52.1-1) from Panchar Mountain, lateral view of the flattened specimen.
Fig. 11 - *Stenarcestes* cf. *diogenis* (Mojsisovics, 1875), specimen MPUM 11834 (11/52.1-3) from Panchar Mountain, a) lateral view, b) detail of the tube worms (?serpulids) encrusting part of the test.
Scale bar is always 10 mm. Long scale bar is for Fig. 7c and 8b; medium scale bar is for Fig. 11b; short scale bar is for all the other specimens.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