

## Lower and Middle Triassic foraminifera from the Eros Limestone, Hydra Island, Greece

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**ABSTRACT** - The systematics and stratigraphic ranges (constrained by conodont dating) of abundant and well preserved foraminiferal faunas from six sections in the Lower and Middle Triassic Eros Limestone of central and western Hydra (Argolis Peninsula, Greece) are described. A joint analysis of the conodonts, foraminifera and bivalves has enabled the Scythian and Anisian stages to be recognized with some certainty within the Eros Limestone carbonate platform. The foraminifera have affinities with those of many other Tethyan localities, in particular the Dinarides, Balkans, Carpathians and the Southern Alps. *J. Micropalaeontol.* **13**(1): 25–46, September 1994.

### INTRODUCTION

The small Island of Hydra is located in the Aegean just to the south of the Argolis Peninsula (Peloponnesus, Greece) (Fig. 1). Its sedimentary succession ranges from Permian to Jurassic in age.

Triassic rocks have been studied by Renz (1906–31), Wendt (1973), Römermann (1968), Römermann *et al.* (1981), Schäfer & Senowbari-Daryan (1984) and by Angiolini *et al.* (1992). From the base, they consist of the Aghios Nikolaos Formation, the Eros Limestone, the Han Bulog Limestone, the Quartz Keratophytic Tuffs and part of the Adhami Limestone and Pantokrator Limestone (Fig. 2). The Lower and Middle Triassic portion of this succession, constituting the carbonate platform of the Eros Limestone, was initially studied by Römermann (1968–9), Römermann *et al.* (1981) and subsequently has seen extensive work by Angiolini *et al.* (1992).

This paper seeks to improve our knowledge of the biostratigraphy of the Eros Limestone by providing new important data on the distribution of some of the Triassic foraminifera, calibrated to the standard stages and substages of the Triassic, using mainly conodonts.

### GEOLOGICAL SETTING

The island of Hydra belongs to the Subpelagonian Zone, defined as a passive continental margin succession deposited on the western part of the Pelagonian Block, according to Jacobshagen *et al.* (1977; 1989 pers. comm.). Both Subpelagonian and Pelagonian zones are part of the Internal Hellenides (Fig. 1).

The sedimentary sequence of Hydra is arranged in four major south vergent thrust sheets, dissected by transcurrent faults (Fig. 3). The Eros Limestone constitutes the backbone of the southern thrust sheet and part of the O. Zakoni and Kutali thrust sheets (nomenclature after Angiolini *et al.* 1992). The areal distribution of the Eros Limestone, together with the schematic tectonic setting of the island, are shown in Fig. 3.

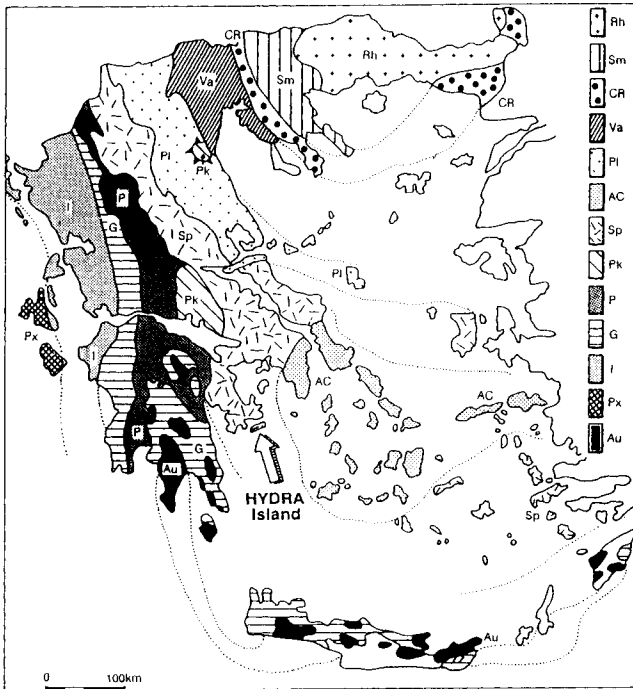
### THE EROS LIMESTONE

The Eros Limestone was named by Römermann (1968) after the highest mountain of Hydra (Mount Eros, 589 m). It constitutes a well-developed carbonate platform, 600–670 m thick, of Early to Middle Triassic age. It overlies the Aghios Nikolaos Formation (quarzarenites; Early Triassic) or directly the Episkopi Limestone (bioclastic limestone; Late Permian) and is bounded at the top by the Han Bulog Limestone (red nodular limestone; latest Pelsonian–latest Illyrian/Ladinian) or directly by the Adhami Limestone (grey cherty limestone; Early Ladinian–Late Triassic).

Angiolini *et al.* (1992) subdivided the Eros Limestone on the basis of microfacies and field analyses. The present work improves these analyses. Six stratigraphic sections are presented here (Fig. 4): sections 1, 3, 4, 5 and 6 were sampled by the present authors, section 2 by M. Richards (University of Lausanne). We have divided the Eros Limestone into four subunits: the lower lithozone, the Eros Limestone *sensu stricto*, the dark member and the upper lithozone.

The **lower lithozone** (25–100 m thick) constitutes the base of the Eros platform (Fig. 2) and consists of grey oolitic limestone with a variable content of quartz grains; yellow siltstone interbeds with species of the bivalve genera *Unionites* and *Eumorphotis* of Spathian age (determination by R. Posenato, University of Ferrara) are also present.

There is a gradual transition from this lithozone into the overlying **Eros Limestone *sensu stricto*** (500–600 m thick), itself subdivided into four main microfacies, from the base to top (Fig. 5): microfacies 1, consisting of oolitic grainstones and packstones with rare bioclasts (gastropods, echinoderms, ostracods, bivalves and foraminifera). It is locally (Aghios Marina) overlain by microfacies 2, consisting of mudstones and wackestones with oolites, intraclasts, peloids and rare bioclasts, or more commonly, it is overlain by microfacies 3, made up of packstones and wackestones with cements and bioclasts (foraminifera, bivalves, ostracods, echinoderms, gastropods, algae, stromatolites and prob-



**Fig. 1.** Structural zones of the Hellenides (modified after Mountrakis *et al.*, 1987). Rh. Rhodope; Sm: Serbomacedonian; CR: Circum Rhodope; Va: Vardar; PI: Pelagonian; AC: Attico-Cycladic; Sp: Subpelagonian; Pk: Parnasos; P: Pindos; G: Gavrovo Tripolis; I: Ionian; Px: Paxos; Au: Plattenkalk-Talea Ori.

lematica). Microfacies 4 has been detected only at O. Malies and consists of bindstones made by encrusting problematica organisms (*Tubiphytes obscurus*, Porostromata and Spongiostromata).

The **dark member** (0–200 m thick) interfingers with the Eros Limestone *sensu stricto* (Fig. 2) and consists of well-bedded platy beds (centimetres to decimetres thick) of dark limestone with chert. Massive beds of intraformational breccias are present and a later dolomitization is also evident.

The dark member and the Eros Limestone *sensu stricto* are overlain by the **upper lithozone** (10–30 m thick), made up of red matrix-bearing calcareous breccias with bioclastic clasts.

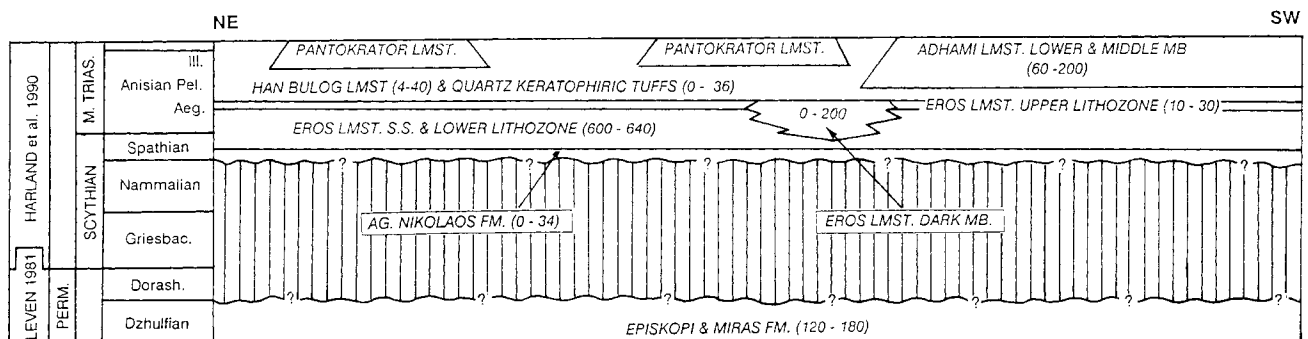
The depositional environment of the Eros Limestone is characteristic of a carbonate platform developed on a marine terrigenous flat (Aghios Nikolaos Formation). Oolitic and bioclastic grainstones and packstones, probably forming sand bars, are widespread. In places (Aghios Marina), these bars seem to have enclosed lower energy areas where mudstones and wackestones were deposited. A hard rim (bindstone) is present in the northeastern part of Hydra (O. Malies) and is apparently localized only at this site. The dark member probably represents not very deep and poorly oxygenated troughs dissecting the carbonate platform. Their areal distribution, in a narrow SW–NE alignment, which together with the presence of abundant intraformational breccias, seems to suggest a tectonic (extensional) origin.

The age of the Eros Limestone ranges from Spathian to the Pelsonian substage of the Anisian (Fig. 2), based on the presence of Spathian bivalves in the lower lithozone, Late Scythian conodonts (*Neospathodus homeri* (Bender) in sample MR225) in the dark member of the Eros Limestone and Pelsonian conodonts (*Gondolella bulgarica* (Budurov & Stefanov), *G. bifurcata bifurcata* (Sudar & Budurov), and *Gladigondolella tethydis* (Huckriede)) in the upper lithozone [all the conodonts listed in this paper and their stratigraphic ranges have been determined by A. Nicora, University of Milan, and are taken from Angiolini *et al.*, 1992]. The foraminiferal assemblages are in agreement with and support this age determination.

**SCYTHIAN FORAMINIFERAL ASSEMBLAGE**

This foraminiferal assemblage is recorded mainly in the lower lithozone, in the dark member of the Eros Limestone and also in microfacies 1 of the Eros Limestone *s.s.* (Fig. 4, sections 1, 2, 4, 5; Table 1). It is characterized by: *Glomospira* spp., *Glomospirella* spp., *Pilammina praedensa* Urošević, *Meandrospira pusilla* (Ho), *Meandrospira cheni* (Ho) and *Krikoumbilica pileiformis* He. The occurrence of the conodont *Neospathodus homeri* (Bender) and the Spathian bivalves (*Unionites* sp. and *Eumorphotis* sp.) in the dark member and lower lithozone of the Eros Limestone, respectively, confirms the Scythian age of this foraminiferal association.

Of interest is the occurrence of *Krikoumbilica pileiformis* He in the Scythian stage; this species, up until now, is known



**Fig. 2.** Stratigraphy of the Triassic succession in Hydra.

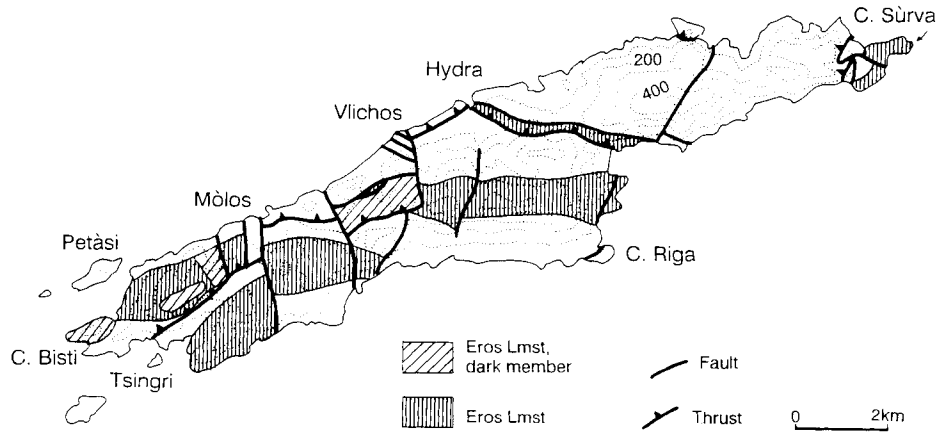


Fig. 3. Geological sketch map showing the distribution of the Eros Limestone (modified after Angiolini *et al.*, 1992).

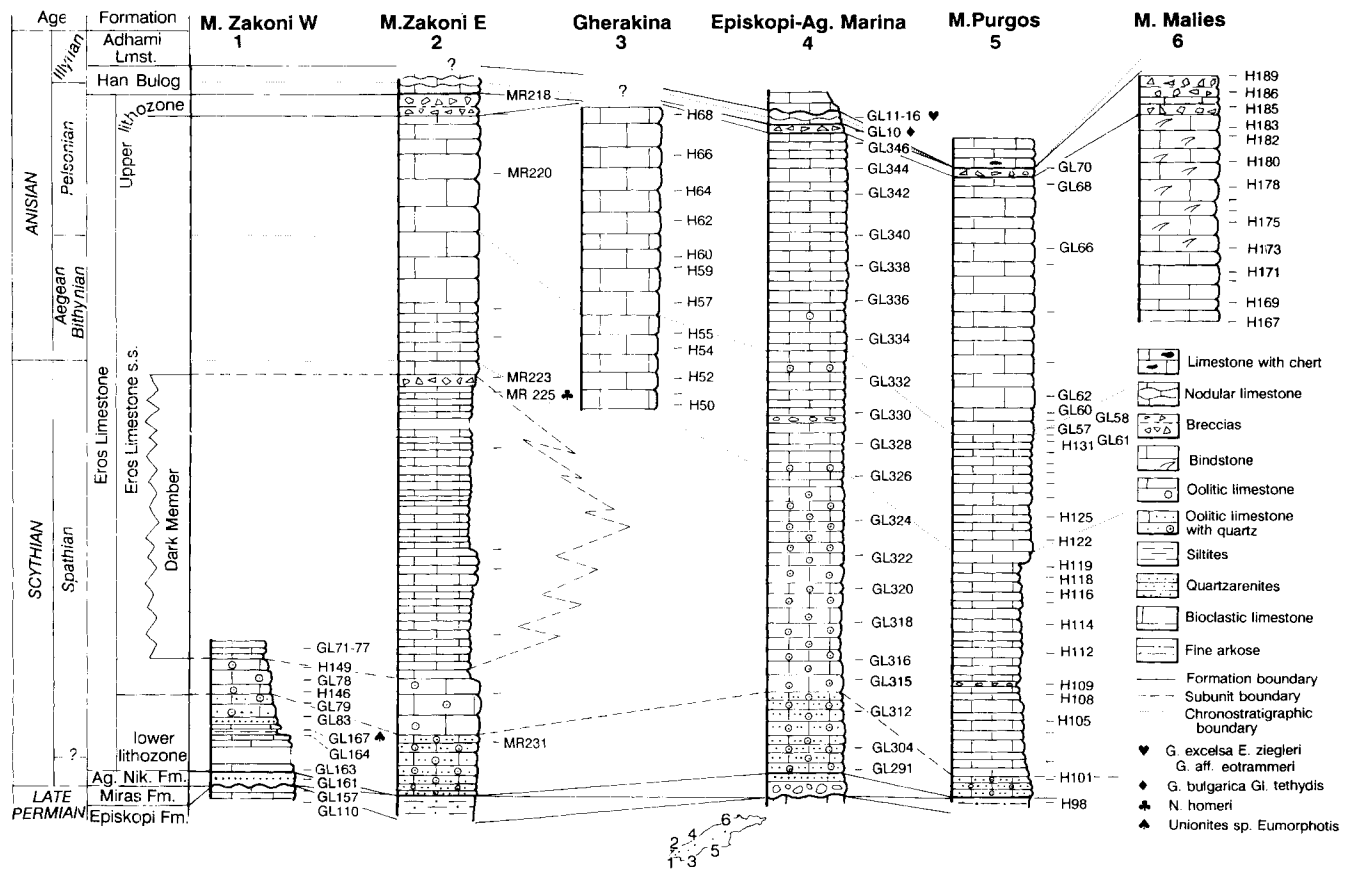
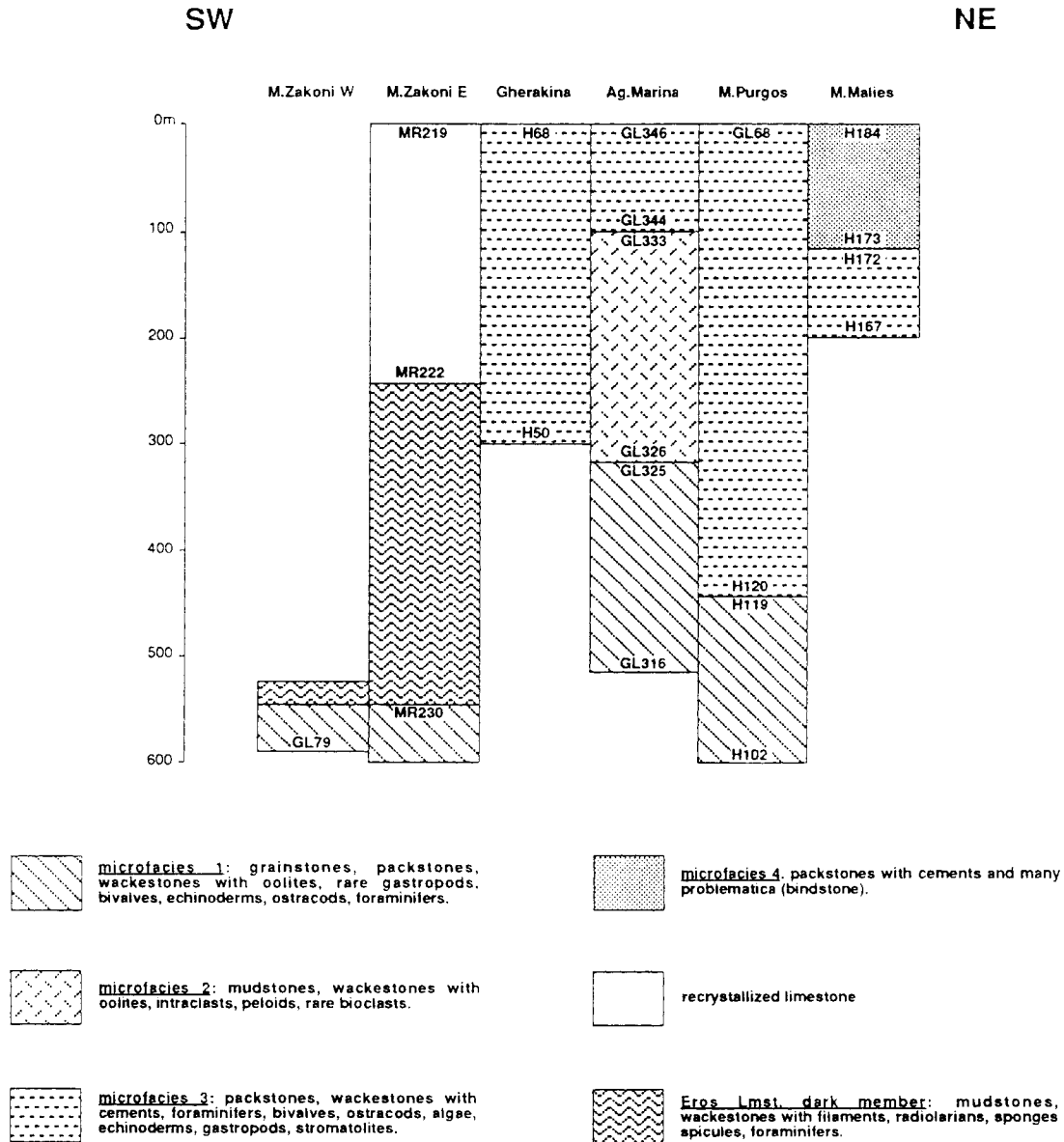


Fig. 4. Stratigraphic sections (left to right: 1–6) measured in the Eros Limestone and their correlation based on foraminiferal and conodont biostratigraphy (for more detailed conodont distribution see Angiolini *et al.*, 1992). To keep the figure more readable, the Eros Limestone s.s. microfacies have not been included. Make reference to Fig. 5, using plotted sample numbers, to locate these microfacies. Section location is as follows: Section 1, southwestern slope of O. Zakoni from 200 m a.s.l. to the summit; Section 2, southeastern slope of O. Zakoni; Section 3, westward of the village of Gherakina from 240 m a.s.l. to the southern coast; Section 4, from the ancient village of Episkopi to Ag. Marina chapel; Section 5, from 290 m a.s.l. on the southern slope to 380 m a.s.l. on the northern slope of O. Purgos; Section 6, along the new road from 180 m a.s.l. above C. Riga towards the northeast (Ag. Triada).



**Fig. 5.** Distribution and thickness of the microfacies of the Eros Limestone s.s. Numbers refer to samples defining the base and top of each microfacies.

only in the Middle Triassic of southern Guizhou (China). Furthermore, in Hydra, the stratigraphic range of *M. pusilla* (Ho) also extends into the Anisian (see below), whereas *M. cheni* (Ho) appears to be restricted to the Scythian.

**ANISIAN FORAMINIFERAL ASSEMBLAGE**

The Anisian foraminiferal assemblage of Hydra is very rich, diverse and well preserved in most samples. It occurs in the Eros Limestone s.s. mainly in microfacies 3 and 4, more rarely in microfacies 2 (Figs 4–5). These foraminifera belong to the Early and Middle Anisian time interval on the basis of the conodont association (listed above) recorded in the upper lithozone of the Eros Limestone, which directly overlies microfacies 3 and 4 of the Eros Limestone s.s. The typical Anisian foraminiferal assemblage is represented by

(Fig. 4, sections 2, 3, 4, 5, 6; Table 1): *Glomospira* spp. (Pl. 1, fig. 11), *Glomospirella grandis* (Salaj), *Glomospirella* spp., *Pilammina densa* Pantic, *Ammobaculites/Reophax* sp., *Earlandia amplimuralis* (Pantic) Fig. 6.2, *Earlandia tintiniformis* (Misik) (Fig. 6.3), *Endothyra* aff. *E. salaji* Gazdzicki (in Gazdzicki *et al.*, 1975), *Endothyra* sp. (Pl. 2, fig. 9, 10), *Endoteba* sp., *Endothyranella wirzi* (Koehn-Zaninetti), *Palaeomiliolina judicariensis* (Premoli Silva), *Meandrospira pusilla* (Ho), *Meandrospira dinarica* Kochansky-Devidé & Pantic, ‘*Meandrospira*’? *deformata* Salaj, *Meandrospiranella* sp., *Turriglomina magna* (Urosevic), *Ophthalmidium* spp. (Figs 6.5, 6.6), *Spirillina* sp. (Pl. 6, fig. 4, 5), *Turrspirillina prealpina* Zaninetti & Brönnimann (in Zaninetti *et al.*, 1972a), *Triadodiscus* or *Aulotortus* n. sp., ?*Lamelliconus* sp. (Pl. 6, fig. 9) and

Sect. 6		Sect. 5		Sect. 4		Sect. 3		Sect. 1	
Sample	Foraminifera	Sample	Foraminifera	Sample	Foraminifera	Sample	Foraminifera	Sample	Foraminifera
H196		GL65		GL346		H65		GL75	<i>Glomospira</i> sp.
H186	X	GL63	X	GL344	X	H64		GL73	<i>Glomospirella grandis</i> (Salaj)
H183	X	GL62	X	GL342		H60	X		<i>Glomospirella</i> ssp.
H177		GL60	X	GL338	X	H59	X		<i>Pilammina densa</i> Pantic
H176		GL59	X	GL334	X	H57			<i>Pilammina praedensa</i> Urosevic
H175		GL58	X			H55	X		<i>Ammobaculites</i> sp./ <i>Reophax</i> sp.
H173	X	GL57	X			H54	X		<i>Earlandia amplimuralis</i> (Pantic)
H171	X	GL56	X			H52			<i>Earlandia tintinniformis</i> (Misik)
H167	X	GL51	X			H51	X		<i>Endothyra</i> aff. <i>E. salaji</i> Gazdzicki
		GL41	X						<i>Endothyra</i> sp.
		GL30	X						<i>Endoteba</i> sp.
		GL28	X						<i>Endothyranella wirzi</i> (Koehn-Zaninetti)
		GL27	X						<i>Palaeomiliolina judicariensis</i> (Premoli Silva)
		GL26	X						<i>Meandrosira pusilla</i> (Ho)
		GL25	X						<i>Meandrosira cheni</i> (Ho)
		GL22	X						<i>Meandrosira dinarica</i> Kochansky-Devidé & Pantic
		GL19	X						<i>"Meandrosira" deformata?</i> Salaj
		GL18	X						<i>Meandrospiranella</i> sp.
		GL10	X						<i>Turriolmina magna</i> (Urosevic)
		GL04	X						<i>Ophthalmidium</i> spp.
		GL03	X						<i>Spirillina</i> sp.
									<i>Turnispirillina prealpina</i> Zaninetti & Brönnimann
									<i>Triadodiscus</i> or <i>Aulotortus</i> n. sp.
									? <i>Lamelliconus</i> sp.
									<i>Krikoumbilica pileiformis</i> He
									<i>Austrocolomia</i> sp.
									Duostominidae
									Aulotortidae or Triadodiscidae

**Table 1.** Chart of Triassic foraminifera from five out of the six measured sections in the Eros Limestone, Hydra. Section 2 is barren of foraminifera.

*Austrocolomia* sp. (Fig. 6.5). Duostominidae (Figs 6.1, 6.4), Nodosariidae and a single section of a specimen tentatively assigned to the family Aulotortidae or Triadodiscidae (Pl. 6, fig. 10) were also found. *Tubiphytes obscurus* Maslov, encrusting foraminifera (*Nubecularia* sp.), dasyclad algae, echinoderm fragments, *Gemeridella minuta* Borza & Misik and *Bacinella irregularis* Radoicic are also present.

In the Eros Limestone (upper lithozone), the joint occurrence of *Meandrosira pusilla* and *M. dinarica* has been detected in sample GL 155 (Tsingri Bay, in front of Tsingry Island, see Fig. 3); the age of this assemblage is Pelsonian on the basis of conodonts. This points to a Scythian-Anisian distribution of *M. pusilla*.

In the overlying Han Bulog Limestone, *T. mesotriasica* (Koehn-Zaninetti) has been discovered in association with an Illyrian conodont fauna characterized by *Gondolella excelsa* (Mosher) and *Gladigondolella tethydis* (sample H4, Vlichos).

The fauna recorded in the Eros Limestone *s.s.* of Hydra is very similar to that occurring in the Anisian bioclastic limestone underlying the Han Bulog Limestone of southern (former) Bosnia-Herzegovina, Yugoslavia (Brönnimann *et al.* 1973a,b). Moreover, it also shows affinities to assemblages of most of the Tethyan Anisian successions recorded by many authors (among others Kochansky-Devidé & Pantic, 1966; Koehn-Zaninetti, 1969; Premoli Silva, 1971; Zaninetti *et al.*, 1972a; Efimova, 1974; Gazdzicki *et al.*, 1975; Dager, 1978; Trifonova, 1978a,b; Salaj *et al.* 1967; Salaj, 1969; Salaj *et al.*, 1983; He, 1984; Oravec-Scheffer, 1987; Urosevic, 1977, 1981, 1988).

**DISCUSSION**

**Biostratigraphic considerations**

Angiolini *et al.* (1992) described the stratigraphy of the Eros Limestone of Hydra, their dating being mainly with the aid of conodont assemblages.

In the present paper we have described the foraminiferal fauna recorded in the same stratigraphic interval, providing further data on the occurrence of some important Early and Middle Triassic foraminifera (Table 2) in the Tethyan realm. Of particular importance are the following:

(A) *Pilammina praedensa*: the Scythian range reported by Urosevic (1988) is here confirmed on the evidence of the associated conodonts and bivalves.

(B) *Pilammina densa*: in Hydra, this species has been recorded only in the Pelsonian.

(C) *Meandrosira*: in the Eros Limestone the distribution of this genus suggests the existence of a lineage (*M. cheni*-*M. dinarica*) evolving laterally from *M. pusilla*. The arguments supporting this interpretation are: first, the Scythian portion of the Eros Limestone hosts both *M. pusilla* and *M. cheni*; secondly, during the Early Anisian *M. dinarica* appears, surviving until the Pelsonian, together with rare specimens of *M. pusilla*; and thirdly, *M. cheni* has been found only in the Spathian substage.

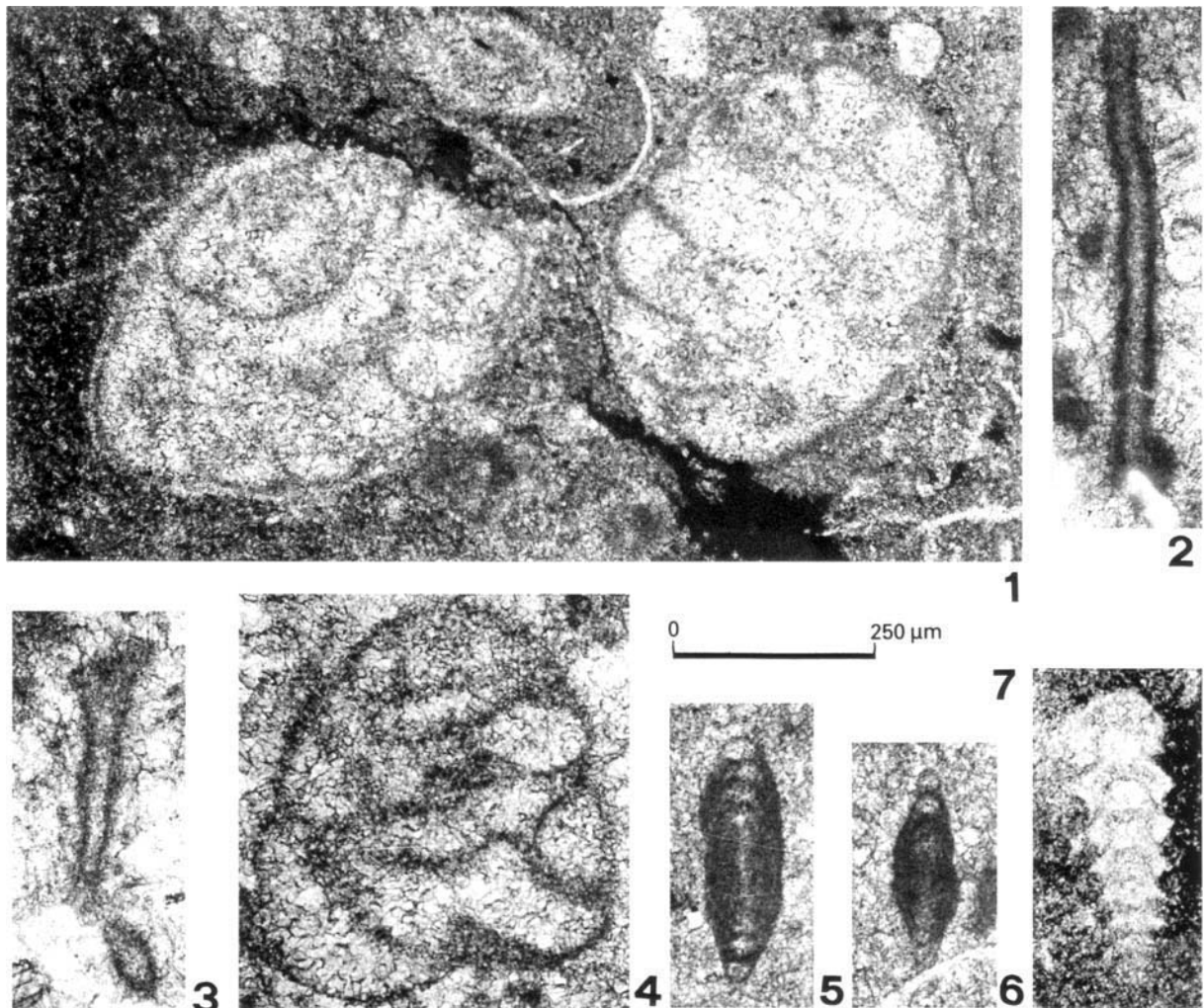
(D) *Krikoumbilica pileiformis*: previously, this species has been known only in the Middle Triassic of China. Therefore, its Scythian occurrence in Hydra indicates that it must have appeared first in the Early Triassic.

(E) *Glomospirella grandis*: in Hydra, it has been found only in the Anisian (as high as the Pelsonian), in association with *Meandrosira dinarica*, thus confirming the restriction of this species to the Anisian.

(F) *Endoteba*: the Upper Permian genus *Endoteba* is reported in the Triassic (Pelsonian) for the first time. A more detailed analysis of Triassic 'Endothyras' is needed to confirm this record.

(G) *Endothyranella wirzi*: this species, also known in the Ladinian (Zaninetti, 1976), is here recorded in the Early Anisian, as high as the Pelsonian. We can confirm that elsewhere this species ranges through the Middle Triassic.

(H) *Palaeomiliolina judicariensis*: appears to be restricted to



**Fig. 6.** Thin sections of foraminifera. 6.1. Duostominidae: ?*Duostomina* sp., sample: H186, stratigraphic section 6. 6.2. *Earlandia amplimuralis* (Pantic), sample: H54, stratigraphic section 3. 6.3. *Earlandia tintinniformis* (Misik), sample: GL342, stratigraphic section 4. Fig. 6.4. Duostominidae: ?*Variostoma* sp., sample: H128, stratigraphic section 5. Fig. 6.5, 6.6. *Ophthalmidium* spp., sample: H55, stratigraphic section 3. Fig. 6.7. *Austrocolomia* sp., sample: H186, stratigraphic section 6.

the Pelsonian (dating based on associated conodonts); this conclusion is confirmed by other authors (i.e. Premoli Silva, 1971; Trifonova, 1979; Oravec-Scheffer, 1987).

(I) *Turriglomina magna*: this species was described by Urosevic in the Carnian-Norian of the Balkans, whereas in Hydra it occurs in the Pelsonian. This confirms the presence of this species in the earliest Middle Triassic, as already suggested by Zaninetti *et al.* (1990).

(J) *Turriglomina mesotriasica*: on the co-occurrence of conodonts, the Middle Triassic range of this species is here confirmed.

(K) *Turrspirillina prealpina*: was recorded for the first time by Zaninetti *et al.*, 1972a in the Late Anisian, whereas in Hydra the species is also present in the Early Anisian only as high as the Pelsonian substage.

(L) *Lamelliconus*: reported in the Pelsonian substage, apparently for the first time.

(M) A new species of *Triadodiscus* or *Aulotortus* has been discovered in the Pelsonian portion of the Eros Limestone s.s. There is an affinity between it and specimens recorded

by Brönnimann *et al.*, 1973a,b (as *Involutina sinuosa pragsoides*) in the Anisian limestone of Bosnia-Herzegovina.

The stratigraphic ranges of the main foraminifera collected in Hydra are shown in Table 2; these results are integrated with data already known from the literature. We do not propose any new foraminiferal zonation but our data has been compared with the zonations proposed by Zaninetti *et al.* (1972a), Salaj *et al.* (1988), and Trifonova (1992). In the schemes of Salaj *et al.* (1988) and Trifonova (1992), a subdivision of the Scythian consisting of a lower, *Meandrospira cheni* Interval Zone and an overlying, *Meandrospira pusilla* Interval Zone, was proposed. In Hydra, *M. cheni* appears after the acme of *M. pusilla* in association with rare specimens of *M. pusilla*, disappearing at the end of the Scythian, whereas *M. pusilla* continues into the Anisian in association with *M. dinarica*.

In terms of systematics, it is noteworthy that we refer to *M. pusilla* the smallest forms belonging to the genus *Meandrospira* of the type-material from China described by Ho (1959), maintaining the name *pusilla* according to the

SCYTHIAN				ANISIAN			LADINIAN		CARNIAN
Griesbachian	Dienkerian	Smithian	Spathian	Bithynian Aegean	Pelsonian	Illyrian	Fassanian	Longobardian	
	---								<i>Meandrospira pusilla</i>
		---							<i>Meandrospira cheni</i>
									<i>Meandrospira dinarica</i>
									<i>Glomospirella grandis</i>
									<i>Pilamina densa</i>
									<i>Palaeomiliolina judicariensis</i>
									<i>Endothyranella wirzi</i>
									<i>Turriplomina mesotriasica</i>
									<i>Turriplomina magna</i>
									<i>Turrispirillina prealpina</i>

**Table 2.** Stratigraphic range of some important Triassic foraminifera according to the literature and from new data from the Island of Hydra. See text for discussion.

law of priority (see synonymy). We refer to *M. cheni* those specimens with morphology and dimensions intermediate between *M. pusilla* and *M. dinarica*, as figured by Ho (1959) (see synonymy). During a visit to the Department of Geology and Palaeontology of the Academic Sinica (Nanjing), one of us (R.R.) examined the original collection of Ho Yen and established the true nature of *M. cheni*.

Salaj *et al.* (1988) established a *M. dinarica* Interval Subzone (Bithynian–Pelsonian) in the lower part of the *Pilamina densa* Range Zone (Bithynian–Illyrian). Trifonova (1992) basically agrees with this zonation but differs in the detail of her subdivisions of the Pelsonian. The *M. dinarica* Subzone was raised to a full Zone by Zaninetti *et al.* (1972a).

In Hydra, *M. dinarica* appears at the base of the Anisian and continues to the top of the Pelsonian, whereas *P. densa* appears during the Pelsonian. According to our data, the range of *M. dinarica* is therefore lower compared to previous zonations. Furthermore, we have found *M. dinarica* in association with *Aulotortus* or *Triadodiscus* n.sp. (= *Involutina sinuosa pragsoides sensu* Brönnimann *et al.*, 1973a).

**Palaeogeographic considerations**

Palaeogeographically, there is a particular similarity between the foraminiferal fauna of Hydra and that recorded by Brönnimann *et al.* (1973a,b) from the Anisian of southern Bosnia-Herzegovina, as well as in other localities of the Dinarides (Kochansky-Devidé & Pantic, 1966; Urosevic, 1977, 1981, 1988). Lithological and faunal similarities suggest a possible correlation between the Dinarides and the Subpelagonian Zone of the Internal Hellenides (Hydra Island).

Our faunas also show many affinities with those reported

from the Middle Triassic of the Southern Alps (Gaetani & Gorza, 1989), the Carpathians (Gazdzicki, *et al.*, 1975; Trifonova, 1978a,b; Oravec-Scheffer, 1987), the Kocaeli Peninsula (Turkey) (Dager, 1878), the Caucasus (Efimova, 1974) and from China (He, 1984).

In the M. Facito Formation *auct.* of the Lagonegro area (Southern Apennines), an Illyrian–Ladinian foraminiferal fauna, calibrated with conodonts (Ciarapica *et al.*, 1990; Mietto *et al.*, 1991), has been studied. This foraminiferal assemblage is similar to the Illyrian fauna recorded in Hydra; particularly they share, amongst others, the species *Turriplomina magna*, *T. mesotriasica* and *Endothyranella wirzi*. During the Pelsonian the carbonate platform of Hydra was characterized by the occurrence of *Meandrospira dinarica*, *Pilamina densa*, *Palaeomiliolina judicariensis*, and *Triadodiscus/Aulotortus* n.sp. This fauna is completely absent in the Lagonegro sequence; in fact, during this period Lagonegro is affected by terrigenous influxes, causing carbonate sedimentation to occur only from Illyrian time.

In conclusion, the two successions of Hydra and Lagonegro show affinities, testifying to a similar evolution of the passive continental margin, even if they were developed at slightly different times. In Hydra, the carbonate platform (Eros Limestone) which had developed from Scythian to Pelsonian time, becoming drowned during the Pelsonian, whereas the carbonate platform of the Lagonegro area is referable to the Illyrian–Longobardian and became drowned at several different times within the Ladinian.

**SYSTEMATIC DESCRIPTIONS**

Citations, post-1976, are given in full to show the wide distribution within Tethys of these important foraminifera and as a supplement to the detailed synonymies given by Zaninetti (1976). The reader is referred to Tables 1 and 2

for the distribution of the species in Hydra. For the position of the samples and for the lithologies quoted in the text below, see also Figs 4, 5.

Order **Foraminiferida** Eichwald, 1830  
Superfamily **Ammodiscacea** Reuss, 1862

Family **Ammodiscidae** Reuss, 1862

Subfamily **Ammoveretellinae** Saidova, 1981

Genus **Glomospirella** Plummer, 1945

**Glomospirella grandis** (Salaj, *in* Salaj, Biely & Bistricki, 1967)

(Pl. 1, figs 9, 10)

For synonymies before 1976, see Zaninetti (1976: 101).

1977 *Glomospirella grandis* (Salaj); Pantic-Prodanovic & Radosevic: 79, pl. 4, figs 3, 4.

1978 *Glomospirella grandis* (Salaj); Dager: 50, pl. 1, fig. 3.

1983 *Pilamminella grandis* Salaj; Salaj *et al.*: 68, pl. 12, figs 1, 2.

1983 *Pilamminella semiplana* (Kochansky-Devidé & Pantic); Salaj *et al.*: 69, pl. 12, fig. 3, 4.

?1989 *Glomospirella semiplana* (Kochansky-Devidé & Pantic); Gaetani & Gorza: 46, pl. 11, figs 7, 8.

1989 *Glomospirella grandis* (Salaj); Gaetani & Gorza: 46, pl. 12, fig. 1.

1990 *Glomospirella falsofriedli* (Salaj, Borza & Samuel); He & Wang: 67, pl. 1, figs 12, 13.

1990 *Glomospirella grandis* (Salaj); He & Wang: 66, pl. 1, figs 15, 16.

1992 *Pilamminella semiplana* (Kochansky-Devidé); Trifonova: 21, pl. 1, fig. 10.

**Remarks.** Among the Triassic glomospirellas it is the largest in size (with a maximum diameter of 1.5 mm according to Zaninetti, 1976). The species is very distinctive as it is characterized by a wide, streptospirally enrolled initial part and then by a planispiral stage (3–5 whorls).

*G. grandis* has been recorded in the Anisian throughout Tethys, often associated with *Pilammina densa* and *Meandrosira dinarica*. The species was named, but not figured, by Ramovs (1972) from the Carnian of Dinarides.

In Hydra, our specimens are associated with *M. dinarica*, ?*Lamelliconus* sp. and *Turrspirillina prealpina* and range from Early Anisian to Pelsonian, on the basis of associated conodonts faunas.

**Occurrence.** O. Purgos, Eros Limestone s.s., section 5, sample H 122, GL 60.

Genus **Pilammina** Pantic, 1965

**Pilammina densa** Pantic, 1965

(Pl. 2, figs 1, 2, 3?, 4, 5?)

For synonymies before 1976, see Zaninetti (1976: 89).

1976 *Glomospira densa* (Pantic); Urosevic & Dumurdanov: 93, pl. 2, fig. 4.

1977 *Glomospira densa* (Pantic); Pantic-Prodanovic & Radosevic: 79, pl. 4, figs 5, 8.

1977 *Glomospira densa* (Pantic); Gazdzicki & Smit: 326, pl. 3 figs 4–9.

1977 *Glomospira densa* (Pantic); Urosevic: pl. 2, figs 6, 7.

1978 *Glomospira densa* Pantic; Dager: 49, pl. 1, fig. 2.

1983 *Pilammina densa* Pantic; Salaj *et al.*: 66, pl. 9, figs 1–4.

1084 *Glomospira densa* (Pantic); He Yan: 422, pl. 1, figs 1–6, 7?.

1986 *Pilammina densa* Pantic; Sudar: 352, pl. 17, figs 1–4.

1988 *Glomospira densa* (Pantic); Pirdeni: 147, pl. 1, figs 8, 9.

1990 *Glomospira* (Pantic); He & Wang: 65, pl. 1, figs 1–10.

1990 *Glomospira densa* Pantic (*sic*); Lualdi & Bianchi: 48, fig. 10 (8).

1992 *Pilammina densa* Pantic; Trifonova: 20, pl. 2, figs. 10, 11; pl. 4, fig. 15.

**Remarks.** The specimens from Hydra are comparable with Pantic's original material, except for the high number of convolutions in the latter (40–60 in Pantic, 1965).

*P. densa* is known from the Anisian of many Tethyan localities (i.e. Dinarides, Hellenides, W. Carpathians, Giudicarie Alps, Northern Calcareous Alps, Swiss Prealps, Kocaeli Peninsula (Turkey), Qinghai and Guizhou provinces of China). The species is frequently mentioned in association with *Meandrosira dinarica* and *Glomospirella grandis*. We have found *P. densa*, together with the same Involutinacea (Triadodiscidae or Aulotortidae) recorded by Brönnimann *et al.* (1973a,b) and assigned by these authors to *Involutina sinuosa pragsoides* (Oberhauser), but we have never found *P. densa* either with *M. dinarica* or *Glomospirella grandis*.

Our specimens occur in the upper part of the stratigraphic sections (5 and 6), attributed to the Pelsonian on the basis of the conodont association (*G. bulgarica*, *G. b. bifurcata*, *G. b. hanbulogi*, *Gl. tethydis*).

**Occurrence.** O. Malies, Eros Limestones s.s., section 6, samples GL 183, GL 185; O. Purgos, Eros Limestone s.s., section 5, sample GL 63; Aghios Marina, Eros Limestone s.s., section 4, sample GL 346; Gherakina, Eros Limestone s.s., section 3, samples H 55, H 59.

**Pilammina praedensa** Urosevic, 1988

(Pl. 1, figs 3, 4)

1988 *Pilammina praedensa* Urosevic: 377, pl. 1, figs 1–6.

**Remarks.** The species can be distinguished from *P. densa* Pantic in being smaller in size, in having a smaller number of convolutions and less tightly coiled initial whorls.

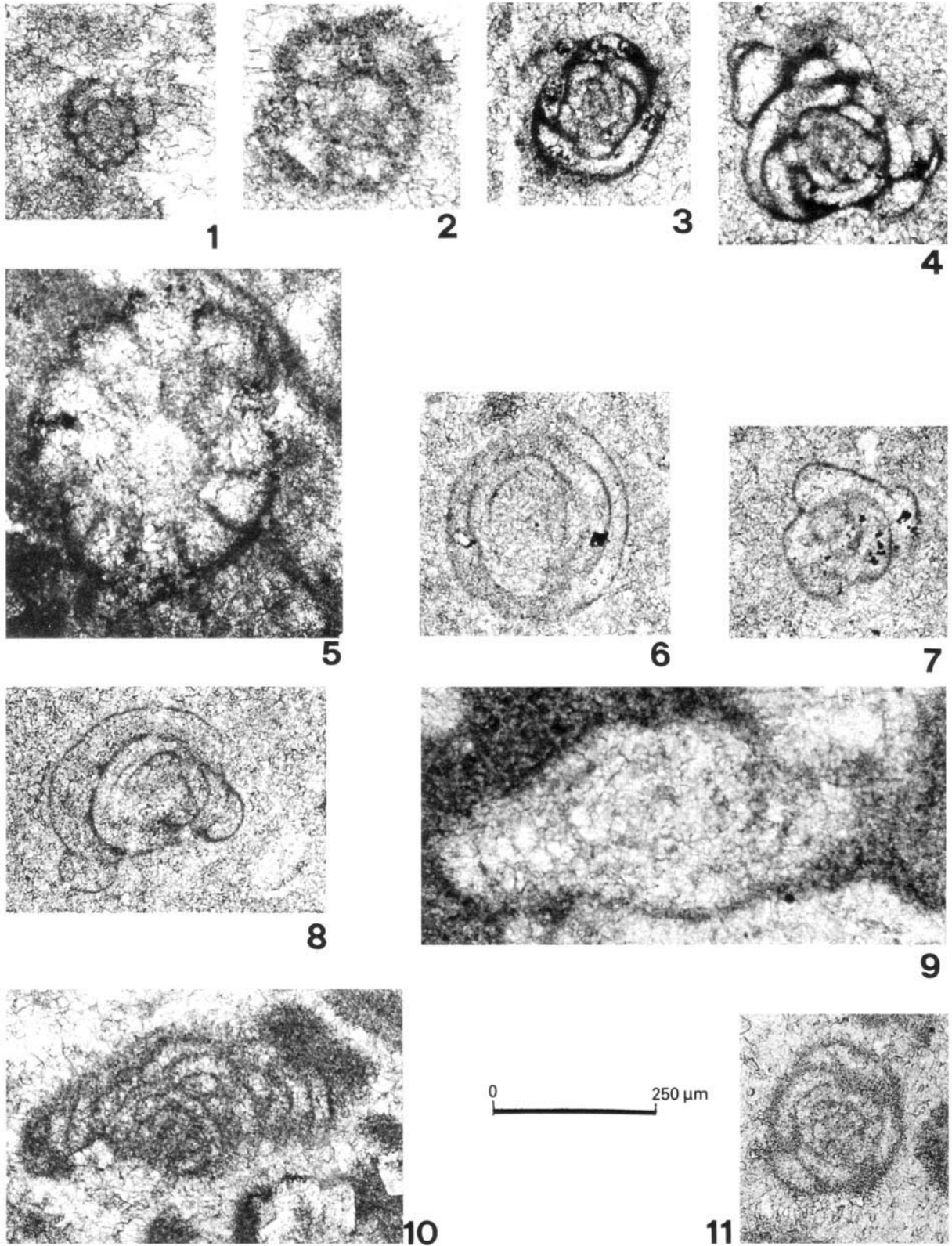
*Pilammina praedensa* is known from the Scythian of the Inner Belt of eastern Serbia. The age of *P. praedensa* is confirmed in Hydra by the presence of Spathian bivalves (*Unionites* sp. and *Eumorphotis* sp.) and Scythian conodonts (*N. homeri*).

He & Cai (1991) determined two specimens recorded in

#### Explanation of Plate 1

Fig. 1. *Meandrosira pusilla* (Ho), sample: H105, stratigraphic section 5. Fig. 2. *Meandrosira cheni* (Ho), sample: H105, stratigraphic section 5. Figs 3,4. *Pilammina praedensa* Urosevic, sample: GL75, stratigraphic section 1. Fig. 5. *Krikoubilica pileiformis* He, sample: H103, stratigraphic section 5. Figs 6, 7, 8. Undetermined foraminifera, sample: GL76, stratigraphic section 1. Figs 9, 10. *Glomospirella grandis* Salaj, samples: fig. 9, GL60, stratigraphic section 5; fig. 10, H122, stratigraphic section 5. Fig. 11. *Glomospira* sp., sample: H51, stratigraphic section 3.





the Middle Triassic Guohua Formation (Guangxi, China) as *Glomospira sigmoidalis* (Rauser) (pl. 1, figs 3, 4). In our opinion these specimens are very similar to *P. praedensa* and possibly synonymous.

**Occurrence.** O. Zakoni W, Eros Limestone, dark member, section 1, sample GL75.

Superfamily **Endothyracea** Brady, 1884

Family **Endothyridae** Brady, 1884

Subfamily **Endothyranospinae** Reytlinger, 1958

Genus **Endothyra** Phillips, 1846,

*Endothyra* aff. *E. salaji* Gazdzicki in Gazdzicki, Trammer & Zawidzka, 1975

(Pl. 2, figs 6–8)

aff. 1975 *Endothyra salaji* Gazdzicki in Gazdzicki, Trammer & Zawidzka: 289, pl. 5, figs 1–6.

1977 *Endothyra malayensis* Gazdzicki & Smit: 324, pl. 8 figs 1–3.

1983 *Endothyra salaji* Gazdzicki; Salaj *et al.*: 90, pl. 38, figs 3, 5.

1984 *Endothyra salaji* Gazdzicki; He: 426, pl. 3, fig. 10.

**Remarks.** Our specimens are very similar to the type-material figures in Gazdzicki *et al.*, 1975, but they show larger dimension. The shape and arrangement of the chambers in the last whorls, together with their tendency to uncoil, suggests an affinity with *E. salaji*.

In our opinion, the species *E. malayensis* Gazdzicki & Smit, from the (probably Ladinian) Koding Limestone (Kedah, North West Malaysia) must be synonymized with *E. salaji* as it is not possible to recognize significant morphological, dimensional and stratigraphical differences to justify a separate species.

As already pointed out by Koehn-Zaninetti (1969), the presence of tectum and diaphanotheca in the wall of Triassic endothyras is never clear; this is related to an evolutionary simplification of the wall or to diagenetic processes. Vachard & Razgallah (1988) suggested that most of the Triassic endothyras and endothyranellas are directly linked with their new genus *Endoteba*, described from the Permian of Jebel Tebaga, Tunisia.

*Endothyra salaji* was recorded by Gazdzicki *et al.* (1975) in the Fassanian Muschelkalk of Poland; Oravec-Scheffer (1987) found, but did not figure the species in the Anisian Falsoör Limestone of Hungary; *E. salaji* also occurs in the Pelsonian–Illyrian of the West Carpathians (Salaj *et al.*, 1983) and possibly also in the Carnian–Norian of the same region (Salaj *et al.*, 1983); it was also recorded in the Middle Triassic of Guizhou (China) (He, 1984). In Hydra, *E. aff. E. salaji* is Early Anisian to Pelsonian in age.

**Occurrence.** O. Purgos, Eros Limestone s.s., section 5, samples H 130, GL 65.

Genus **Endoteba** Vachard & Razgallah, 1988

**Endoteba** sp.

(Pl. 2, fig. 11)

**Remarks.** Only one specimen, an equatorial cross-section, corresponds to the morphology of the genus *Endoteba* as described by Vachard & Razgallah, 1988 (type species *Endoteba controversa*, found in the Permian of Jebel Tebaga, Tunisia).

Previously, *Endoteba* was known only from the Permian, but here it is recorded in the Triassic. However, Vachard & Razgallah suggest that many Triassic endothyras are morphologically very close to *Endoteba* and propose a phylogenetic trend between the two genera.

In the Hydra section the genus *Endoteba* occurs in the Pelsonian.

**Occurrence.** O. Malies, Eros Limestone s.s., section 6, sample H 175.

Genus **Endothyranella** Galloway & Harlton, 1930

**Endothyranella wirzi** (Koehn-Zaninetti, 1968)

(Pl. 2, fig. 12; Pl. 3, figs 1, 2, 3?, 6; Pl. 4, fig. 5b)

For synonymies before 1976, see Zaninetti (1976: 129)

1977 *Endothyranella wirzi* (Koehn-Zaninetti); Gazdzicki & Smit: 323, pl. 7 fig. 10.

1978 *Endothyranella wirzi* (Koehn-Zaninetti); Dager: 54, pl. 1, fig. 19.

1979? *Endothyranella wirzi* (Koehn-Zaninetti); He Yan: 1168, pl. 73, fig. 2.

1983 *Endothyranella wirtzi* (sic) (Koehn-Zaninetti); Salaj *et al.*: 93, pl. 45, figs 2, 3; pl. 61, figs 1–4.

1983? *Endothyranella aff. wirtzi* (sic) (Koehn-Zaninetti); Salaj *et al.*: pl. 48, fig. 1.

1986 *Endothyranella wirzi* (Koehn-Zaninetti); Sudar: 209, pl. 18, fig. 4.

1987 *Endothyranella wirzi* (Koehn-Zaninetti); Oravec-Scheffer: 95, pl. XX, figs 1–2, 4, 7–9.

1987 *Endothyranella cf. wirzi* (Koehn-Zaninetti); Oravec-Scheffer: pl. 20, figs 3, 5.

1987 *Endothyranella?* sp.; Oravec-Scheffer: pl. 20, fig. 6.

1988 *Endothyranella wirzi* (Koehn-Zaninetti); Pirdeni: 147, pl. 1, fig. 10.

1988 *Endothyranella* sp.; Pirdeni: pl. 1, fig. 11.

1989 *Endothyranella wirzi* (Koehn-Zaninetti); Gaetani & Gorza: 44, pl. 12, fig. 2.

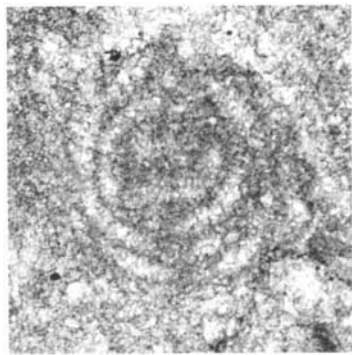
1989 *Ammobaculites radstattensis* (sic) Kristan-Tollmann; Gaetani & Gorza: pl. 12, fig. 3. [Note the mistake in the explanation of the plate: the caption of fig. 4 must be referred to fig. 3 and vice versa].

1990 *Endothyranella wirzi* (Koehn-Zaninetti); Ciarapica *et al.*: 154, Fig. 5E.

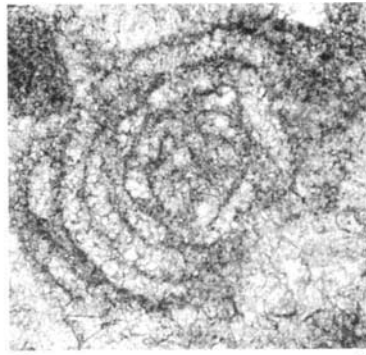
1991 *Ammobaculites radstattensis* Kristan-Tollmann; He & Cai: pl. 1, figs 20–22.

#### Explanation of Plate 2

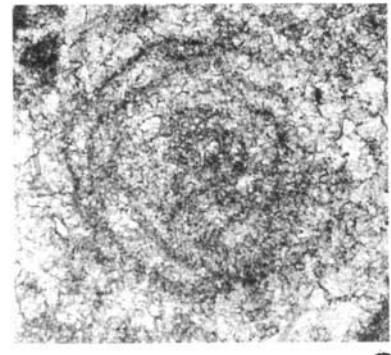
Figs 1, 2, 3?, 4, 5? *Pilamina densa* Pantic, samples: fig. 1, H183, stratigraphic section 6; fig. 2, H59, stratigraphic section 5; fig. 3, H55, stratigraphic section 3; figs 4, H185, stratigraphic section 6; fig. 5, GL346, stratigraphic section 4. Figs 6–8. *Endothyra* aff. *E. salaji* Gazdzicki, samples: fig. 6, H130, stratigraphic section 5; fig. 7, H130, stratigraphic section 5; 8, GL65, stratigraphic section 5. Figs 9, 10. *Endothyra* sp., samples: fig. 9, H171, stratigraphic section 6; fig. 10, H173, Stratigraphic section 6. Fig. 11. *Endoteba* sp., sample: H175, stratigraphic section 6. Fig. 12. *Endothyranella wirzi* Koehn-Zaninetti, sample: H64, stratigraphic section 3.



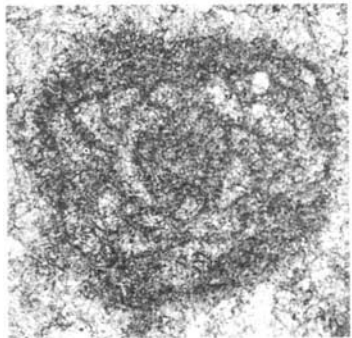
1



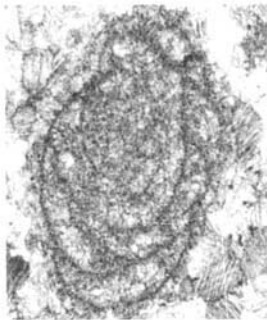
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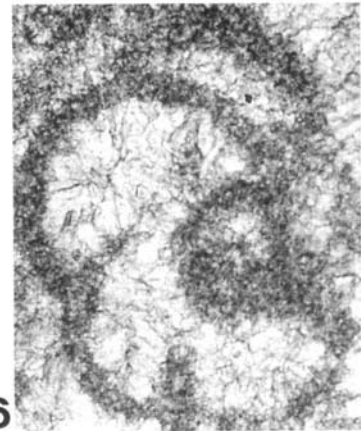
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4



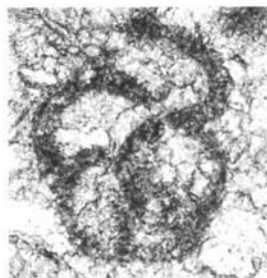
5



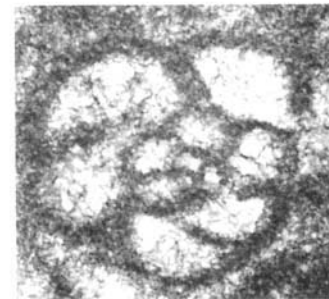
6



7



8



9



10



11



12

**Remarks.** All the specimens assigned to *E. wirzi* have characteristics comparable with those mentioned in the original description by Koehn-Zaninetti (1969), although it was not always possible to observe the coiled stage. The globular embracing chambers, the terminal aperture produced on a neck in the uniserial part and the thin microgranular or finely agglutinating wall are diagnostic characteristics of the species.

The specimen figures in our Pl. 2, fig. 12 and others from the literature show a change of coiling plane in the spiral part, this character confirming the attribution of the species to *Endothyranella* Galloway & Harlton, rather than to *Ammobaculites* Cushman, as originally described.

*Endothyranella wirzi* is known in the Tethyan Middle Triassic, occurring in the Anisian (Koehn-Zaninetti, 1969) and in the Ladinian (Zaninetti, 1976). In Hydra we have recorded the species in the Early Anisian (as high as the Pelsonian).

**Occurrence.** Gherakina, Eros Limestone s.s., section 3, sample H 64; O. Purgos, Eros Limestone s.s., section 5, samples H 126, H 128, H 129; O. Malies, Eros Limestone s.s., section 6, sample H 176.

Superfamily **Cornuspiracea** Schultze, 1854

Family **Meandrospiridae** Saidova, 1981

Subfamily **Meandrospirinae** Saidova, 1981

Genus **Meandrospira** Loeblich & Tappan, 1946

**Meandrospira pusilla** (Ho, 1959)

(Pl. 1, fig. 1; Pl. 4, fig. 14)

1959 *Trochamminoides pusillus* Ho: 416, pl. 7, figs. 18–29; pl. 8, figs. 1–5.

1959 *Trochamminoides flosculiformis* Ho: 416, pl. 8, figs. 6–10.

1959 *Trochamminoides insolitus* Ho: 416, pl. 8, figs. 11?, 12?, 13–15.

1959 *Trochamminoides cheni* Ho: 416 (in part), pl. 8, figs 18, 19 not figs 16, 17.

1964 *Citaella iulia Premoli Silva*: 661, pl. 48, figs 1–20; pl. 49, figs 1–20; pl. 50, figs 1–7; pl. 51, fig. 5.

For other synonymies before 1976, see Zaninetti (1976: 135).

1976 *Meandrospira pusilla* (Ho); Zaninetti: 135, pl. 1, figs 5–7, 9–11, not fig. 8.

1976 *Meandrospira* forma *pusilla* Farabegoli *et al.*: 679, figs.6a, b, f.

1976 *Meandrospira* forma *insolita* or *pusilla* Farabegoli *et al.*: fig. 6e.

1976 *Meandrospira julia* (Premoli Silva); Urosevic & Dumurdanov: 93, pl. 1, fig. 2.

1976 *Meandrospira pusilla* (Ho); Urosevic & Dumurdanov: 93, pl. 1, fig. 6.

1977 *Meandrospira iulia* (Premoli Silva); Pantic-Prodanovic & Radosevic: 76, pl. 2, figs 6–7.

1977 *Meandrospira pusilla* (Ho); Trifonova: 32, pl. 2, figs 1, 2; pl. 3, fig. 3.

1977 *Meandrospira pusilla* (Ho); Gazdzicki & Smit: 326, pl. 4, figs 8–10.

1978 *Meandrospira pusilla* (Ho); Dager: 55, pl. 2, figs 7, 8.

1983 *Meandrospira pusilla* (Ho); Salaj *et al.*: 101, pl. 55, figs 1–15.

?1983 *Meandrospira insolita* (Ho); Salaj *et al.*: 100, pl. 55, figs 16?, 17–19a, 19b.

1983 *Meandrospira cheni* (Ho); Salaj *et al.*: 99, pl. 56, figs 6, 8, 10, 11, 12, 14, 18.

1987 *Meandrospira pusilla* (Ho); Oravec-Scheffer: 113, pl. 8, fig. 15; pl. 9, figs 1, 2, 4; pl. 11, figs 1, 4, 5.

1988 *Meandrospira pusilla* (Ho); Pirdeni: 146, pl. 1, figs 1–4.

1988 *Meandrospira pusilla* (Ho); He: 89, pl. 2, figs 10, 12.

1988 *Meandrospira immatura* He: 92, pl. 2, figs 13, 14.

1988 *Meandrospira insolita* (Ho); He: 89, pl. 2, figs 15–18.

1988 *Meandrospira pusilla* (Ho); Trifonova & Catalov: 80, pl. 1, fig. 15.

1990 *Meandrospira pusilla* (Ho); Lualdi & Bianchi: 46, Fig. 10 (2a).

1990 *Meandrospira pusilla* (Ho); Baroz *et al.*: 28, pl. 4, figs 1–6, 9, 11, 12.

**Remarks.** Although very rare in our samples from Hydra, our few specimens are morphologically referable to some of the type specimens illustrated by Ho (1959) from the Lower Triassic Chialingkiang Limestone (He, 1979, 1988) of South Szechuan (China) (see also above). *M. pusilla* is very common in the lower Triassic of all parts of Tethys. It is associated with *M. cheni* in sample H104, Scythian (probably Spathian) in age, and with *M. dinarica* in the sample GL 155 (Pelsonian in age on the basis of conodonts). The presence of rare specimens of *M. pusilla* in the Anisian has already been established by several authors (i.e. Salaj *et al.*, 1967; Bechstädt & Bradner, 1970; Brönnimann *et al.*, 1973a,b; Farabegoli *et al.*, 1976). In Hydra the coexistence of *M. pusilla* and *M. dinarica* in sediments containing Pelsonian conodonts confirms that even if the acme of *M. pusilla* does occur during the Early Triassic, in favourable palaeoecological conditions (Zaninetti, 1976; Farabegoli *et al.*, 1976; Oravec-Scheffer, 1987) this species continues into the Anisian.

**Occurrence.** O. Purgos, Eros Limestone s.s., section 5, sample H 104, H 105; Tsingri Bay, Eros Limestone, upper lithozone, sample GL 155.

**Meandrospira cheni** (Ho), 1959

(Pl. 1, fig. 2)

1959 *Trochamminoides cheni* Ho: 416 (in part), pl. 8, figs 16, 17, not figs 18, 19.

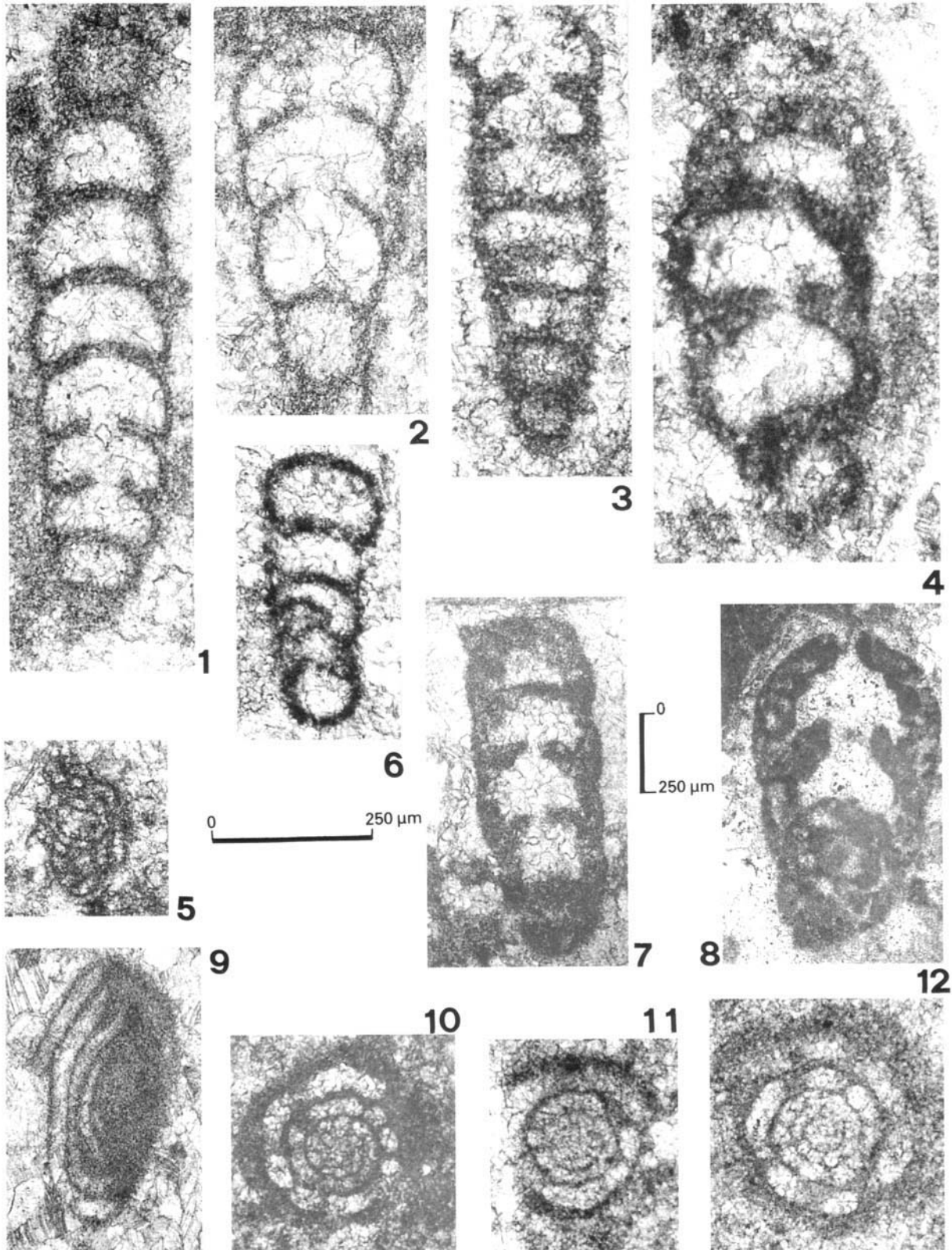
1976 *Meandrospira pusilla* (Ho); Zaninetti: 135, pl. 1, fig. 8.

1976 *Meandrospira forma gigantea* Farabegoli *et al.*: 679, fig. 6d, g, h.

1983 *Meandrospira pusilla* (Ho); Salaj *et al.*: 101, pl. 56, figs 1–5, 7?, 9, 13?, 15?, 16?, 17?, 19.

### Explanation of Plate 3

Figs 1, 2, 3?, 6. *Endothyranella wirzi* Koehn-Zaninetti, samples: fig. 1, H126, stratigraphic section 5; fig. 2, H176, stratigraphic section 6; fig. 3, H129, stratigraphic section 5; fig. 6, H64, stratigraphic section 3. Figs 4, 7, 8. *Ammobaculites* sp./*Reophax* sp., samples: fig. 4, H126, stratigraphic section 5; 7, H130, stratigraphic section 5; fig. 8, GL62, stratigraphic section 5. (The vertical scale bar refers to figs 7, 8). Figs 5, 9. *Palaeomiliolina judicariensis* (Premoli Silva), samples: figs 10, 11, H125, stratigraphic section 5; fig. 12, H126, stratigraphic section 5.



1990 *Meandrosira cheni* (Ho): Baroz *et al.*: 28, pl. 4, figs 13–18.

**Remarks.** In association with rare specimens of *M. pusilla* in the Scythian of Hydra, we have recorded a few specimens distinguishable from *M. pusilla* on the basis of a reduced number of zigzag bends, together with a smaller size of test and deuterochamber. Morphologically these specimens are comparable with part of the type-material of *Meandrosira cheni* (= *Trochamminoides cheni* Ho, 1959) from China. This species has long been considered a synonym of *M. pusilla*. Recently, Baroz *et al.* (1990) asserted the validity of *M. cheni*, recorded together with *M. pusilla*, in the Lower Triassic of the Oreokastro mountain belt (Greece) and we agree with them in considering *M. cheni* a transitional form between *M. pusilla* and *M. dinarica*. A phylogenetic lineage within this group had already been commented upon by Farabegoli *et al.* (1976) and by Oravec-Scheffer (1987). These authors proposed, however, a link through the informal taxon '*Meandrosira forma gigantea*' of Farabegoli *et al.* (1976), recorded in association with both *M. pusilla* and *M. dinarica*. As already noted by Baroz *et al.* (1990), Farabegoli *et al.*'s specimens of '*M. forma gigantea*', found in association with *M. pusilla*, show affinities with *M. cheni*, whereas those associated with *M. dinarica* fall within the intraspecific variation of *M. dinarica*. Specimens of '*M. gigantea*' figured also by Oravec-Scheffer (1987) (pl. 13, figs 1–4) seem to belong to *dinarica*.

In conclusion, we can confirm that in Hydra *M. cheni* occurs together with rare specimens of *M. pusilla* at the base of the Eros Limestone *s.s.*, in the Scythian (probably Spathian), and it is never found above this level. In contrast, *M. pusilla* is present also in the later, Pelsonian portion of Eros Limestone (upper lithozone) together with *M. dinarica*.

**Occurrence.** O. Purgos, Eros Limestone *s.s.*, section 5, sample H 105.

***Meandrosira dinarica*** Kochansky-Devidé & Pantic, 1966  
(Pl. 3, figs 10–12; Pl. 4, figs 1–13, 15; Pl. 5, figs 1–2)

1966 *Meandrosira dinarica* Kochansky-Devidé & Pantic: 21, pl. 3, figs 9–11; pl. 4, figs 1–10.

1966 *Meandrosira* sp.: Kochansky-Devidé & Pantic: pl. 4, fig. 11.

For other synonymies before 1976, see Zaninetti (1976: 133)

1976 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Urosevic & Dumurdanov: 93, pl. 2, figs 1, 2.

1977 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Pantic-Prodanovic & Radosevic: 79, pl. 4, figs 1, 2.

1978 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Dager: 54, pl. 2, fig. 6.

1983 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Salaj *et al.*: 99, pl. 47, fig. 4; pl. 51, figs 1–8; pl. 52, figs 1–8.

1983 *Meandrospiranella* (Kochansky-Devidé & Pantic; 1966) n. sp.; Salaj *et al.*: 28, fig. 8.

1984 *Meandrosira dinarica* Kochansky-Devidé & Pantic; He: 429, pl. 3, figs 4–6?, 7–9.

1986 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Sudar: pl. 19, figs 1–5.

1987 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Oravec-Scheffer: 113, pl. 19, figs 1?, 2?, 3?, 4–11, 14.

1988 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Pirdeni: 1437, pl. 1, fig. 7.

1989 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Gaetani & Gorza: pl. 10, fig. 2; pl. 1, fig. 5 (not named).

1990 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Baroz *et al.*: 30, pl. 5, figs 4–9.

1990 *Meandrosira dinarica* Kochansky-Devidé & Pantic; Lualdi & Bianchi: 48, fig. 10 (7).

**Remarks.** The Hydra specimens are close to the original description of the species, even though they are smaller in size (diameter of the test 0.20–0.35 mm) than those figured by Kochansky-Devidé & Pantic (1966). The specimen figured by Kochansky-Devidé & Pantic (1966, pl. 4, fig. 11) and named *Meandrosira* sp. was distinguished by them because '*...die kleiner als die M. dinarica und mehr nautiloid ist, dünnere Wände und einen noch langsameren Zuwachs hat...*' (1966: 27). The same specimen was considered by Salaj *et al.* (1983) to be a new species belonging to the genus *Meandrospiranella* Salaj, but they did not elaborate further in the text. In our view, this specimen is an axial cross-section of *M. dinarica* whose dimensions and morphology can be considered as intraspecific variation.

*M. dinarica* has been recorded in the Anisian of all Tethyan regions. In Hydra, *M. dinarica* occurs in the Early Anisian as high as the Pelsonian.

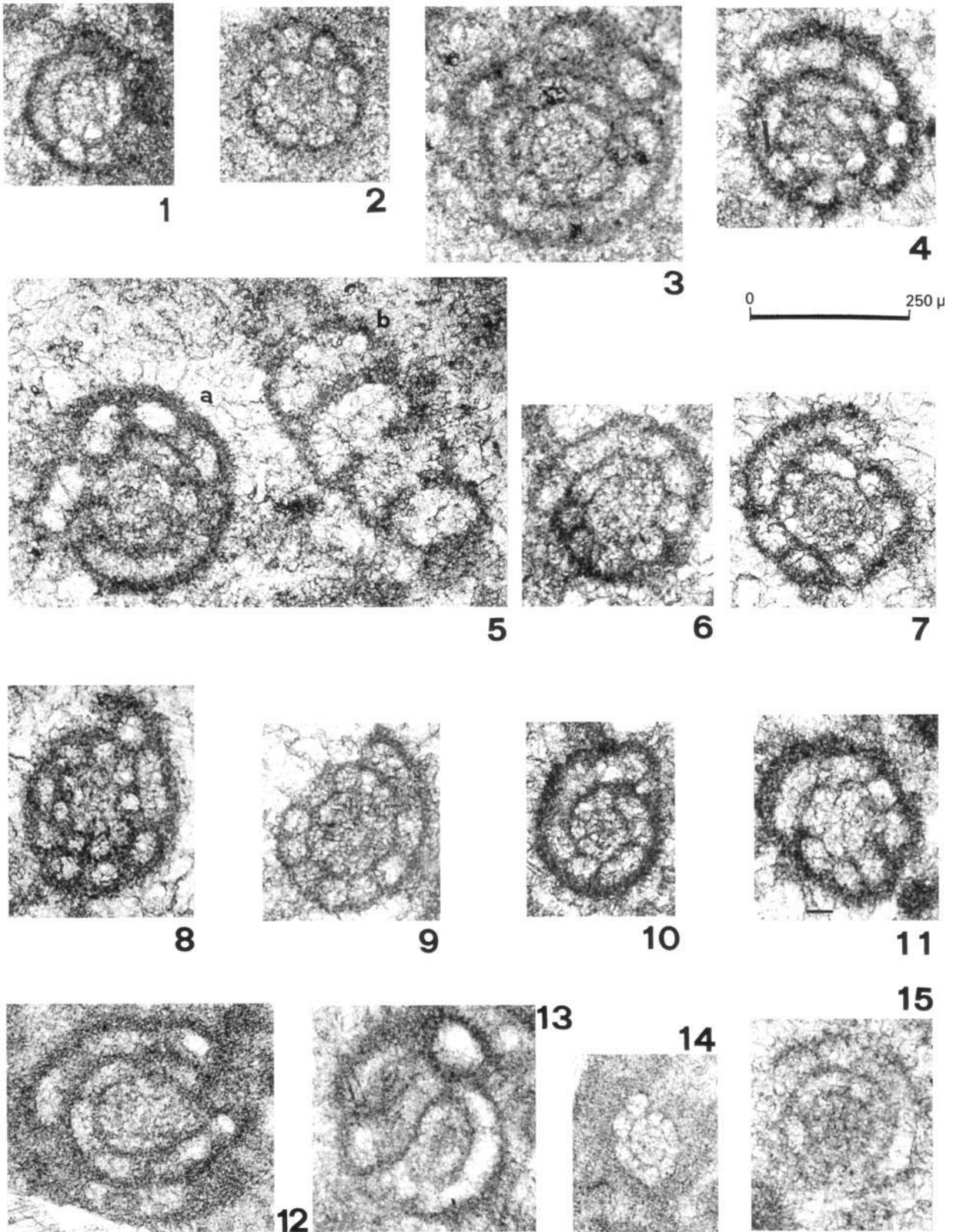
**Occurrence.** Gherakina, Eros Limestone *s.s.*, section 3, samples H 60, H 66; Episkopi, Eros Limestone *s.s.*, section 4, sample GL 342; O. Purgos, Eros Limestone *s.s.*, section 5, samples H 125, H 126, H 127, H 128, GL 61, GL 58, GL 59, GL 60; O. Malies, Eros Limestone *s.s.*, section 6, sample H 167; Tsingri Bay, Eros Limestone, upper lithozone, sample GL 155.

**'*Meandrosira*' ?*deformata*** Salaj *in* Salaj, Biely & Bistricky, 1967  
(Pl. 5, figs 3–7)

**Remarks.** In sample GL 334 we have found some specimens consisting of a globular proloculus and an undivided, tubular second chamber irregularly coiled; the wall is porcelaneous. These forms are very close to those

#### Explanation of Plate 4

Figs 1–4. *Meandrosira dinarica* Kochansky-Devidé & Pantic, samples: figs 1, 2, H126, stratigraphic section 5; figs 3, 4, H127, stratigraphic section 5. Fig. 5a (left) *Meandrosira dinarica* Kochansky-Devidé & Pantic; b (right) *Endothenella wirzi* Kohen-Zaninetti, sample: H178, Stratigraphic section 6. Figs 6–13. *Meandrosira dinarica* Kochansky-Devidé & Pantic, samples: fig. 6, H128, stratigraphic section 5; fig. 7, H128, stratigraphic section 5; fig. 8, GL59, stratigraphic section 5; fig. 9, GL59, stratigraphic section 5; fig. 10, GL342, stratigraphic section 4; fig. 11, GL60, stratigraphic section 5; fig. 12, GL155, Eros Limestone, upper lithozone; fig. 13, GL155, Eros Limestone, upper lithozone. Fig. 14. *Meandrosira pusilla* (Ho), sample: GL155, Eros Limestone, upper lithozone. Fig. 15. *Meandrosira dinarica* Kochansky-Devidé & Pantic, sample: H60, stratigraphic section 3.



figured by Trifonova (1972, pl. 2, figs 4, 5) and Salaj *et al.* (1983, pl. 54, figs 1–6) and included in the taxon *Meandrospira deformata* Salaj, 1967 by them. Similar specimens have also been identified by Gazdzicki *et al.* (1975, pl. 7, figs 9–16) as *Meandrospira? deformata* Salaj. In our opinion all these specimens, including those from Hydra, do not correspond in shape and dimension to the holotype of *Meandrospira deformata* as figured originally by Salaj *et al.* (1967, pl. 2, fig. 3d) and by Salaj *et al.* (1983, pl. 53, fig. 4). The Hydra specimens were recorded near the base of the Pelsonian substage.

**Occurrence.** Between Episkopi and Aghios Marina, Eros Limestone *s.s.*, section 4, sample GL334.

Genus *Meandrospiranella* Salaj, 1969

*Meandrospiranella?* sp.

(Pl. 5, figs 8–11; Pl. 6, fig. 1)

**Remarks.** Our specimens have been assigned to *Meandrospiranella* with reservation because only a slight tendency to uncoil can be observed. The Hydra species, at present left in open nomenclature, can be distinguished from *Meandrospiranella samueli* Salaj (in Salaj *et al.*, 1967) in having a larger test (0.55–0.6 mm) and deuteroocular (0.055–0.065 mm) diameter (cf. also type material figured by Salaj, Borza & Samuel, 1983, pl. 57, figs 1–5). *Meandrospiranella?* sp. has been recorded from Early Anisian to Pelsonian strata.

**Occurrence.** Episkopi, Eros Limestone *s.s.*, section 4, sample G1342; O. Purgos, Eros Limestone *s.s.*, section 5, samples H 125, H 126, H 127.

Subfamily *Turriglomininae* Zaninetti in Limongi *et al.*, 1987

Genus *Turriglomina* Zaninetti in Limongi *et al.*, 1987

*Turriglomina mesotriasica* (Koehn-Zaninetti, 1968)

(Pl. 6, fig. 3)

For synonymies before 1976, see Zaninetti (1976: 105).

1978a *Turritellella? mesotriassica* (*sic*) Koehn-Zaninetti; Trifonova: 101, pl. 2, fig. 11.

1978b *Turritellella mesotriassica* (*sic*) Koehn-Zaninetti; Trifonova: 58, pl. 2, fig. 1.

1978 '*Turritellella*' *mesotriasica* Koehn-Zaninetti; Dager: 50, pl. 1, figs 9, 10.

1979 *Turritellella mesotriasica* Koehn-Zaninetti; He: 1169, pl. 73, fig. 6.

1983 '*Turritellella*' *mesotriasica* Koehn-Zaninetti; Salaj *et al.*: 70, pl. 16, fig. 1.

1985 *Turritellella mesotriassica* (*sic*) Koehn-Zaninetti; Sotak: 94, pl. 1, fig. 1.

1987 *Turritellella mesotriasica* Koehn-Zaninetti; Oravec-Scheffer: 111, pl. 16, figs 3, 7?.

1987 '*Turritellella*' *mesotriasica* Koehn-Zaninetti; Oravec-Scheffer: pl. 28, fig. 1; pl. 31, figs 1, 2, 5, 6?, 7 (not fig. 8).

1987 *Turritellella mesotriasica* Koehn-Zaninetti; He & Yue: pl. 1, figs 16–22.

1987 *Turritellella lataxis* He & Yue: pl. 2, figs 3–5, 13, 14.

?1987 *Turritellella* cf. *mesotriasica* Koehn-Zaninetti; He & Yue: pl. 2, figs 1, 2.

1990 *Turriglomina mesotriasica* (Koehn-Zaninetti) (forme A?); Zaninetti *et al.*: pl. 1, fig. 12.

1990 *Turritellella lataxis* He & Yue; He & Wang: 224, pl. 2, figs 12, 17, 18.

1991 *Turriglomina mesotriasica* (Koehn-Zaninetti); He & Cai: 217, pl. 2, figs 19, 20, 25.

**Remarks.** The specimens from Hydra correspond morphologically to the re-description given by Limongi *et al.* (1987). We now consider the Chinese species *Turriglomina lataxis* (He & Yue, 1987) (= *Turritellella lataxis* He & Yue, 1987) to be synonymous with *T. mesotriasica*. In our opinion the specimens figured by He & Yue (1987; pl. 2, figs 3–5, 13, 14, holotype fig. 4) and He & Wang (1991; pl. 2, figs 12–17) are merely different cross-sections of *T. mesotriasica*. In fact, the diagnostic parameters of *T. lataxis* fall within the intraspecific variation of *mesotriasica*, as originally given by Koehn-Zaninetti.

*T. mesotriasica* is known from the Middle Triassic of many Tethyan regions (Zaninetti, 1976): the Balkans, Kocaeli Peninsula (Turkey), Carpathians (Czechoslovakia, Hungary), Southern Apennines (Italy), and Guangxi and Sichuan Provinces (China). In Hydra it has been found in association with an Illyrian conodont fauna characterized by *G. excelsa* and *Gl. tethydis* (see above).

**Occurrence.** Vlichos, Han Bulog Limestone., sample H 4.

*Turriglomina magna* (Urosevic, 1981)

(Pl. 6, fig. 2)

1977 '*Turritellella*' *mesotriasica* Koehn-Zaninetti; Urosevic: pl. 1, figs 1–9, 10?, 11–15.

1981 *Turritellella magna* Urosevic: 114, pl. 2, figs 1–2

1987 *Turriglomina mesotriasica* (Koehn-Zaninetti); Limongi *et al.*: 13, figs 2A, B.

1987 *Turriglomina mesotriasica* (Koehn-Zaninetti), forme B, ou *Turriglomina* n. sp., ou *Turriglomina* n. sp. ou *Turriglomina?*; Zaninetti *et al.*: 177, pl. 1, fig. 2.

1988 *Glomoturritellella magna* (Urosevic); Urosevic: 377, pl. 2, figs 1, 1a–5.

1990 *Turriglomina magna* (Urosevic); Ciarapica *et al.*: figs 4B, C.

1990 cf. *Turriglomina magna* (Urosevic) (forme B?); Zaninetti *et al.*: 295, pl. 1, figs 4, 7, 8?.

1990 *Turriglomina magna* (Urosevic) (forme B?); Zaninetti *et al.*: pl. 1, figs 5, 6.

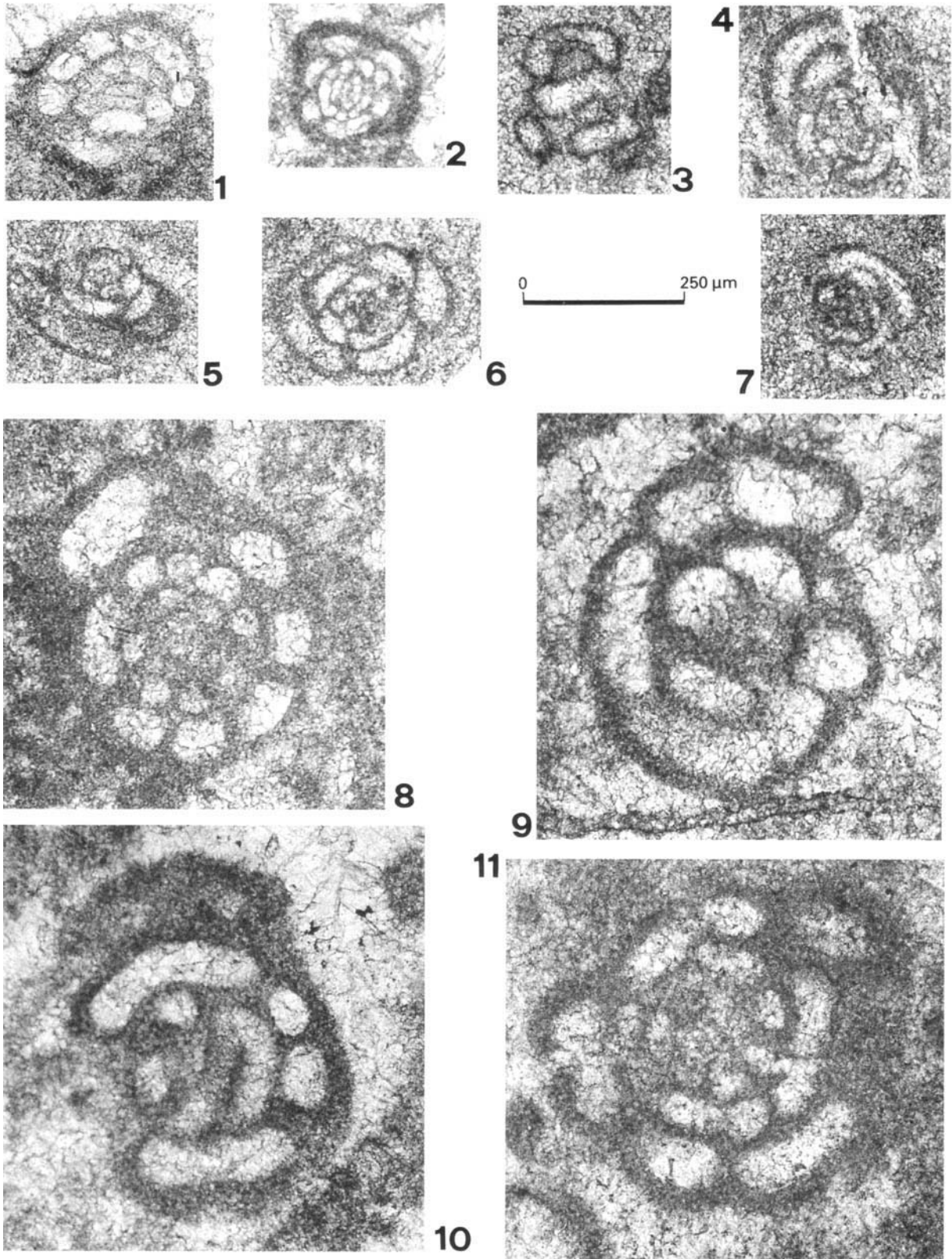
1990 cf. *Turriglomina magna* (Urosevic) (forme A?); Zaninetti *et al.*: pl. 1, figs 10–11.

1991 *Turriglomina guangxiensis* He in He & Cai: 228, pl. 2, figs 15–18, 21–24; pl. 4, figs 1–4, 9.

#### Explanation of Plate 5

Figs 1, 2. *Meandrospira dinarica* Kochansky-Devidé & Pantic, sample: H66, stratigraphic section 3. Figs 3–7. '*Meandrospira*' ?*deformata* Salaj, sample: GL334, stratigraphic section 4. Figs 8–11. *Meandrospiranella* sp., samples: figs 8, 9, H125, stratigraphic section 5; fig. 10, H127, stratigraphic section 5; fig. 11, H126, stratigraphic section 5;





**Remarks.** Our specimen is morphologically (particularly dimensions, height 0.4 mm) very similar to *Turriplomina magna* (Urosevic, 1981) [= *Glomoturitelletta magna* (Urosevic, 1981, 1988), originally recorded from the Carnian–Norian? limestones of the Balkans. Urosevic (1981) claimed to have observed the existence of dimorphism in this species, but the morphological differences of the two supposed generations are not clear. Neither we nor Zaninetti *et al.* (1990) could recognize dimorphism in our material, but can confirm the occurrence of the species in the Middle Triassic of Hydra and the Southern Apennines (M. Facito Formation *auct.*), respectively. In Hydra we have recorded it in the lower part of the Pelsonian.

The Chinese species *Turriplomina guagxiensis* He (*in* He & Cai, 1991) is here considered to be a synonym of *T. magna*, since the morphology and the dimensional parameters are the same in the two species.

**Occurrence.** O. Purgos, Eros Limestone *s.s.*, section 5, sample GL 57.

Superfamily **Miliolacea** Ehrenberg, 1839

Family **Spiroloculinidae** Wiesner, 1920

Genus **Palaeomiliolina** Antonova, 1959

**Palaeomiliolina judicariensis** (Premoli Silva, 1971)

(Pl. 3, figs 5, 9)

1971 *Agathammina judicariensis* Premoli Silva: 343, pl. 29, figs 1, 2, 3, 5, 6.

1975 *Agathammina judicariensis* Premoli Silva; Gazdzicki *et al.*: pl. 6, figs 1–2.

1976 *Agathammina judicariensis* Premoli Silva; Zaninetti: 132, pl. 5, figs 8, 9.

1977 *Agathammina judicariensis* Premoli Silva; Urosevic: pl. 2, figs 1–5.

1979 *Palaeomiliolina judicariensis* (Premoli Silva); Trifonova: 9, pl. 1, figs 1–6.

1987 *Palaeomiliolina judicariensis* (Premoli Silva); Oravec-Scheffer: pl. 15, fig. 14.

**Remarks.** In 1971 Premoli Silva described a new bilocular foraminifer coiled in about five planes (as in *Quinqueloculina*) and with two or three planispiral whorls, assigning this taxon to *Agathammina* Neumayr, 1887. Later, Trifonova (1979) referred this species to the genus *Palaeomiliolina* Antonova, 1959, because her new analysis demonstrated that it has chambers with a quinqueloculine coiling which sometimes have a tendency to a sigmoidine arrangement in the last whorls. The chamber arrangement of our specimens is in agreement with the generic placement of *judicariensis* within *Palaeomiliolina* as proposed by Trifonova (1979). According to Premoli Silva (1971), *P. judicariensis* appears in the Pelsonian at about the same time as the disappearance of *Meandrospira*

*dinarica* (= *Citaella dinarica* in Premoli Silva, 1971). Trifonova found *P. judicariensis* in Pelsonian limestones in Bulgaria and Gazdzicki *et al.* (1975) and Oravec-Scheffer also recorded the species in the Pelsonian (the Muschelkalk) of Poland and Hungary (Felsőőr Limestone), respectively. In Hydra, *P. judicariensis* and *M. dinarica* occur at the same stratigraphical level in the Pelsonian substage; even if we have never found the two species in the same sample, it is possible that the two could coexist.

**Occurrence.** Episkopi, Eros Limestone *s.s.*, section 4, sample GL346; O. Malies, Eros Limestone *s.s.*, section 6, sample H 177.

Suborder **Spirillinina** Hohenegger & Piller, 1975

Family **Spirillinidae** Reuss & Fritsch, 1861

Genus: **Turrispirillina** Cushman, 1927

**Turrispirillina prealpina** Zaninetti & Brönnimann in Zaninetti, Brönnimann & Baud, 1972a

(Pl. 6, figs 6, 7)

1972a *Turrispirillina prealpina* Zaninetti & Brönnimann *in* Zaninetti, Brönnimann & Baud: 480, pl. 6, figs 1–18; pl. 7, figs 4–7, 9, 10; pl. 9, figs 21, 22, 25–35; pl. 11, fig. 14.

1976 *Turrispirillina prealpina* Zaninetti & Brönnimann; Zaninetti: 155, pl. 14, figs 26–30.

1983 *Turrispirillina prealpina* Zaninetti & Brönnimann; Salaj *et al.*: 131, pl. 7, fig. 1.

**Remarks.** Our specimens are very similar to those described by Zaninetti *et al.*, 1972a. The test is evolute with a high spire, but our cross-sections are always oblique, so that it is not possible to evaluate the exact apical angle, which however, appears to be fall within the same interval (90–140°) given by the original authors. The ratio of height versus basal diameter is about 1, allowing *T. prealpina* to be distinguished from *T. minima* Pantic, whose ratio ranges from 1:2 to 2:3. The distinction between these two species is also based on the fact that, in section, the deuterochamber of *T. minima* is not as circular as that of *T. prealpina* and the coiling is semi-involute.

The calcareous hyaline wall of *T. prealpina* is not well preserved in our material, because of the presence of an encrusted surface.

According to Zaninetti *et al.* (1972a,b), *T. prealpina* occurs in the late Anisian of the Swiss Prealps. In Hydra, it occurs in Early Anisian to Pelsonian strata.

**Occurrence.** O. Purgos, Eros Limestone *s.s.*, section 5, samples GL 60, H 127.

Superfamily **Involutinacea** Bütschli, 1880

Family **Triadodiscidae** Zaninetti, 1984 or

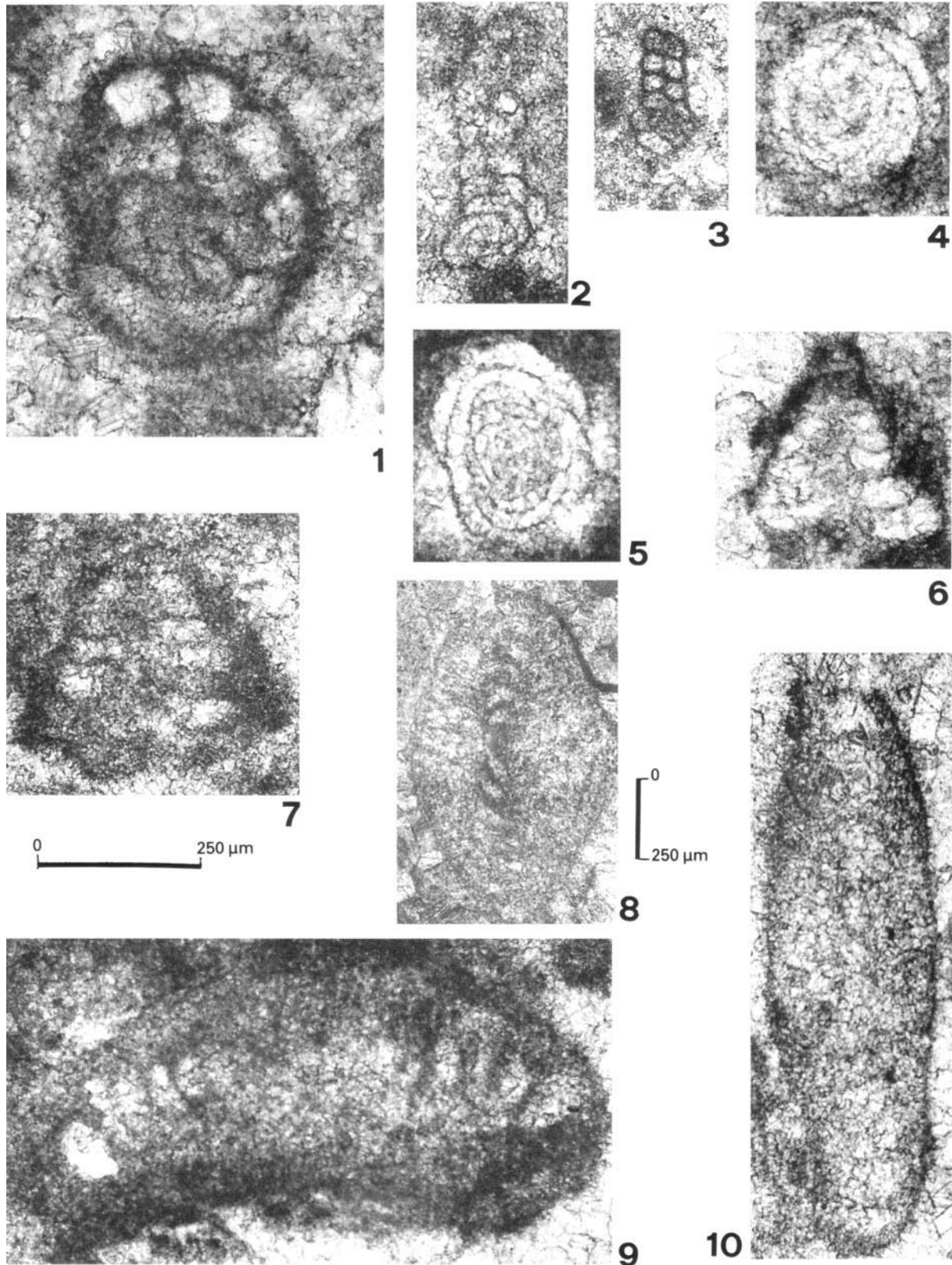
**Aulotortidae** Zaninetti, 1984

Subfamily **Triadodiscinae** Zaninetti, 1984 or

**Aulotortinae** Zaninetti, 1984

#### Explanation of Plate 6

Fig. 1. *Meandrospiranella* sp., sample: GL342, stratigraphic section 4. Fig. 2. *Turriplomina magna* (Urosevic), sample: GL57, stratigraphic section 5. Fig. 3. *Turriplomina mesotriasica* (Koehn-Zaninetti), sample: H4, Han Bulog Limestone, Vlichos. Figs 4, 5. *Spirillina* sp., sample: GL60, stratigraphic section 5. Figs 6, 7. *Turrispirillina prealpina* Zaninetti & Brönnimann, samples: fig. 6: GL60, stratigraphic section 5; 7: H127, stratigraphic section 5. Fig. 8. *Triadodiscus* or *Aulotortus* n.sp., sample: H185, stratigraphic section 6. (The vertical scale refers to fig. 8). Fig. 9. *Lamelliconus* sp., sample: GL60, stratigraphic section 5. Fig. 10. *Triadodiscidae* or *Aulotortidae*, sample: GL61, stratigraphic section 5.



Genus *Triadodiscus* Piller, 1983 or *Aulotortus*  
Weynschenk, 1956

*Triadodiscus* or *Aulotortus* n. sp.  
(Pl. 6, fig. 8)

1973a *Involutina sinuosa pragsoides* (Oberhauser);  
Brönnimann *et al.*: 315, pl. 19, figs 1–18; pl. 20, figs 1–7, 9,  
10, 13; fig. 1a–t.

1975 *Involutina sinuosa pragsoides* (Oberhauser); Gazdzicki  
*et al.*: pl. 10, fig. 9.

**Remarks.** The specimens from Hydra are like those  
figured by Brönnimann *et al.* (1973a) from the Anisian of  
Bosnia-Herzegovina and named by them as *Involutina*  
*sinuosa pragsoides* (Oberhauser). In our opinion, the new  
species can be distinguished from *I. sinuosa pragsoides* in  
having much larger test diameter (1.1 mm), a very small  
diameter of the deuterolocus (0.05 mm in the early  
whorls) and a marked peculiar rhomboid shape. A  
detailed revision of the material by Brönnimann, Cadet &  
Zaninetti (1973a) is necessary before this species can  
formally be described and assigned to the correct genus.

It is also present in the Pelsonian Muschelkalk of  
Southern Poland (Gazdzicki *et al.*, 1975); in Hydra, on the  
basis of the presence of the conodonts *G. b. bifurcata*, *G. b.*  
*hanbulogi* and *G. bulgarica*, its occurrence is Late Pelsonian  
in age.

**Occurrence.** O. Malies, Eros Limestone, upper lithozone,  
section 6, sample H 185.

Superfamily **Duostominacea** Brotzen, 1963

Family **Duostominidae** Brotzen, 1963

Genus *Krikoumbilica* He, 1984

*Krikoumbilica pileiformis* He, 1984

(Pl. 1, fig. 5)

1973a Duostominidae: *Diplotremina?* sp. Kristan-Tollmann;  
Brönnimann *et al.*: pl. 21, figs 14, ?16.

1975 *Diplotremina astrofimbriata* Kristan-Tollmann; Gazdzicki  
*et al.*: pl. 6, figs 4, 5?, 6.

1984 *Krikoumbilica pileiformis* He: 430, pl. 2, figs 9, 10, 12,  
13; pl. 4, figs 8–11 (also recorded as *pileiformis* on p. 430).

1991 *Krikoumbilica pileiformis* He; He & Cai: pl. 2, figs 1, 2,  
3, 5?, 6; pl. 4, figs 8, 11?.

**Remarks.** The specimen illustrated by us is very similar to  
the holotype illustrated by He (1984). The species is  
characterized by a circular umbilicus, whose margin is not  
lobate like that in *Diplotremina* Kristan-Tollmann.

Loeblich & Tappan (1987) assigned the Genus  
*Krikoumbilica* to the family Oberhauserellidae Fuchs, but  
the wall of *Krikoumbilica* is calcareous microgranula while  
that of the Oberhauserellidae is calcareous hyaline.  
According to Koehn-Zaninetti (1969), the Anisian specim-  
ens of the Duostominidae usually exhibit one microgranular  
calcareous layer, which represents the outer preserved layer of  
the double wall of the test; this is also confirmed by Premoli  
Silva (1971). We therefore agree with the assignment of *K.*  
*pileiformis* by He (1984: 426) to the Duostominidae.

He (1984) discovered *K. pileiformis* in the Middle Triassic  
Qingyan Formation and Yangliujing Limestone of southern  
Guizhou, China. All the other citations in our synonymy are  
Middle Triassic in age and were recorded in the

Muschelkalk of southern Poland (Gazdzicki *et al.*, 1975) and  
in the Anisian reefal limestones of Bosnia-Herzegovina  
(Brönnimann *et al.*, 1973a). In Hydra it is recorded for the  
first time from the Scythian on the basis of the presence of  
the conodont *Neospathodus homeri* (Bender) in the same  
sample.

**Occurrence.** O. Purgos, Eros Limestone s.s., section 5,  
sample H 103.

#### Lituolidae of uncertain generic classification

(Pl. 3, figs 4, 7–8)

In our material there are several sections of foraminifera  
with agglutinated or microgranula walls, often large in size.  
These have been assigned to *Ammobaculites* sp./*Reophax*  
sp. as their cross-sections do not show the initial part, which  
could be planispiral or uniserial. Sometimes in the literature,  
authors (i.e. Premoli Silva, 1971; Salaj *et al.*, 1983,  
Oravec-Scheffer, 1987; Trifonova, 1992) have assigned  
these specimens to *Earlandinita*. We do not agree with this  
assignment because the initial spire, which is the main  
diagnostic character used to distinguish the different genera,  
is never recognizable.

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