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LATE TRIASSIC (CARNIAN) FORAMINIFERS OF NORTHEASTERN CORTINA D'AMPEZZO (TAMARIN, SAN CASSIANO FM., DOLOMITES, ITALY)

Abstract - DI BARI DONATO & BARACCA ALBERTO - Late Triassic (Carnian) Foraminifers of Northeastern Cortina d'Ampezzo (Tamarin, San Cassiano Fm., Dolomites, Italy).

This paper describes the Carnian foraminiferal assemblage from San Cassiano Formation of the Tamarin section. Most of the species studied are quoted for the first time and their lower Carnian age (*Aonoides Zone*) is based on a rich ammonoid fauna. The foraminiferal zonation of the materials studied has been ascribed to the *Glomospira kutani* Assemblage Zone on the basis of some typical species belonging to this assemblage. The new species *Duostomina tamarinense* is also described.

Key words: Foraminiferida - Taxonomy - Biostratigraphy - San Cassiano Fm. - Carnian - Dolomites.

Riassunto - DI BARI DONATO & BARACCA ALBERTO - Foraminiferi del Trias superiore (Carnico) della parte Nord-Est della conca ampezzana (Tamarin, Formazione di San Cassiano, Dolomiti, Italia.

Viene descritta l'associazione a Foraminiferi provenienti dalla Formazione di San Cassiano nella sezione stratigrafica di Tamarin.

I sedimenti della Formazione di S. Cassiano, depositatisi in aree bacinali, sono geometricamente interdigitati con le progradanti coeve piattaforme cassiane e sono organizzati in sequenze deposizionali. Dal punto di vista della stratigrafia sequenziale i sedimenti della successione di Tamarin appartengono alla sequenza deposizionale che comprende la Dolomia Cassiana superiore, di età attribuibile al Cordevolico, *Zona ad Aonoides* (sensu URLICHS, 1994) in base alle faune ad ammoniti. La sezione stratigrafica di Tamarin è una sequenza potente circa 50 metri di alternanze di marne pelitiche scure e torbiditi biocalcarenitiche, packstone e wackstone bioclastici e calcari micritici; i campioni a foraminiferi provengono dai livelli marnoso-pelitici.

La maggior parte delle specie studiate sono segnalate qui per la prima volta; l'associazione faunistica è relativamente omogenea lungo tutta la sezione, varia invece l'abbondanza delle varie

specie. I generi *Duostomina* e *Lenticulina* sono dominanti, frequenti anche le specie *Ophtalmidium lucidum*, *O. triadicum*, *Ammodiscus annulinoides*, *Ammodiscus infimus* e *Pragsoconolus robustus*; piuttosto rare invece le specie rappresentanti le famiglie Nodosaridae, Aulotortidae e Triadodiscidae. In riferimento alla zonazione a Foraminiferi la fauna studiata è stata inquadrata nella Zona di Associazione a *Glomospira kutani* sulla base della presenza di *Variostoma pralongense, Variostoma exile, Lamelliconus ventroplanus, Ophtalmidium fusiforme* e *Pragsoconulus robustus.* La presenza in sedimenti bacinali di foraminiferi tipici della facies di scogliera è spiegabile con le modalità di deposizione di tipo torbiditico.

La classificazione utilizzata, salvo alcuni casi, è quella proposta da LOEBLICH & TAPPAN (1988). La specie *Duostomina tamarinense* viene proposta come nuova.

Parole chiave: Foraminiferida - Tassonomia - Biostratigrafia - Formazione di San Cassiano, Carnico - Dolomiti.

1. INTRODUCTION AND SCOPE OF THE PRESENT STUDY

The Cassian fauna has been well documented over the last century due of its extremely diverse, small-sized and excellently preserved invertebrate content.

The sediments of the San Cassiano Formation were deposited in basin areas and are geometrically interfingered with the coeval prograding Cassian platforms (BOSELLINI, 1984, 1988, 1989; BOSELLINI & DOGLIONI, 1988; DE ZANCHE *et alii,* 1993). According to these authors the Cassian succession is organized in two depositional sequences. The first one includes the Lower Cassian Dolomites and San Cassiano Fm. of Cordevolian age (*Aon Zone* p.p.), while the second one the Upper Cassian Dolomites and San Cassiano Fm. of Cordevolian (end of the *Aon Zone*) and Julian age (*Aonoides* and *Austriacum Zones*). The basinal sediments of the Tamarin section belong to the latter depositional sequence.

Recently NERI *et alii* (1994), dated the Sella platform as Late Ladinian in age (*Regoledanus Zone*). This carbonate platform has always been included in the first depositional sequence, therefore either the latter one is older or there could be more than two depositional sequences.

In the Ampezzo valley the San Cassiano Fm. is poorly exposed, as it is covered by woodlands and frequently subject to landslides. However, segments of the lithological sequence outcrop in several localities. The Tamarin section is one of the well exposed examples.

Although many Authors have studied the Tamarin fauna, they have mostly been concerned with ammonoid and conodont fauna (BIZZARINI et alii, 1986, 1990; BIZZARINI & BRAGA, 1987; BIZZARINI, 1988; URLICHS, 1994; MASTANDREA, 1995). The foraminiferal content has never been studied in detail.

The material investigated consists of numerous well preserved isolated benthic foraminifers washed out from the marls.

This paper seeks to improve the knowledge of the Carnian foraminifers by providing new data on their assemblages and distribution, the latter one based

on ammonoid data. With few exceptions the classification by LOEBLICH & TAPPAN (1988) is applied. The new species *Duostomina tamarinense* is also described.

2. THE TAMARIN SECTION

The Tamarin section is one of the well-known outcrops of the San Cassiano Fm. It lies in the Ampezzan Valley about 3 kilometers north-east of Cortina d'Ampezzo (Belluno) (fig. 1). The thickness of the section is about 50 m. It outcrops in a woodland landslide area where it is very difficult to recognize the underlying and the overlying strata.

The outcrop consists mainly of black marls alternating with coarse biocalcarenitic turbidites, bioclastic packstone and wackstone and micritic limestone.

The outcrop is very rich in fossils, such as microcrinoids, echinoderm remains, gastropods, bivalves, ostracods, brachiopods, foraminifers, ammonoids and conodonts.

From the biostratigraphic point of view the Tamarin section has been studied by various authors on the basis of ammonoid and conodont faunas. They ascribed this section either to the upper part of the *Aonoides Zone* (Cordevolian sensu URLICHS, 1994) or to the *Austriacum Zone* (Julian) (BIZZARINI et alii, 1986, 1990; BIZZARINI & BRAGA, 1987; BIZZARINI, 1988; MASTANDREA, 1995).

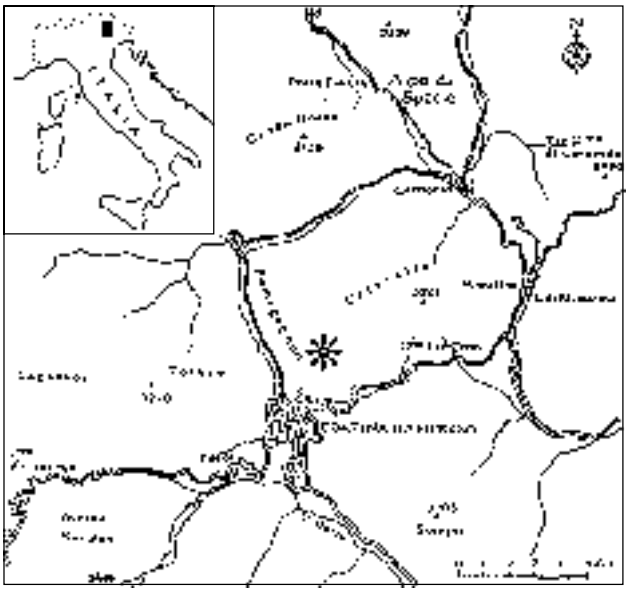


Fig. 1 - Index-map to collection locality (Tamarin), Northeastern Dolomites, Italy.

3. Foraminiferal content and biostratigraphic considerations

The foraminiferal content of the Tamarin section is relatively homogeneous along the entire section. The main difference is connected to the abundance of the various species (fig. 2). *Duostomina* Kristan-Tollmann, 1960 and *Lenticulina* Lamarck, 1804 are dominant with a number of individuals. They include the following species: *Duostomina biconvexa* Kristan-Tollmann, 1960, *Duostomina rotundata* Kristan-Tollmann, 1960, *Duostomina tamarinense* n. sp., *Lenticulina bochardi* (Terquem, 1864), *Lenticulina cassiana* (Gümbel, 1869), *Lenticulina excavata* (Terquem, 1864) and *Lenticulina subquadrata* (Terquem, 1862).

The species *Ophtalmidium lucidum* (Trifonova, 1962), *Ophtalmidium triadicum* (Kristan, 1957), *Ammodiscus annulinoides* Kristan-Tollmann, 1970, *Ammodiscus infimus* (Strickland, 1846) and *Pragsoconulus robustus* Oberhauser, 1963 are also abundant, while the species ascribed to the family Nodosaridae Ehrenberg, 1838, Aulotortidae Zaninetti, 1984 and Triadodiscidae Zaninetti, 1984 are relatively scarce. Some specimens belonging to *Dentalina* Risso, 1926 have been not identified (Pl. 4, fig. 2).

Although all of the foraminifers studied have been found in basin facies some of them, such as *Aulotortus* Weynschenk, 1956, *Lamelliconus* Piller, 1978, are fossils typical of reef facies (Piller, 1978; Gazdzicki, 1983). We consider *Pragsoconulus* Oberhauser, 1963, to be one of these. Their occurrence in the basin facies of the Tamarin area depend on the turbiditic system characterizing the San Cassiano Fm. whereby many fossils are transported from the platform to the basin.

Considering the foraminiferal zonation we ascribe the faunas studied from Tamarin section to the *Glomospira kutani* Assemblage Zone on the basis of *Variostoma pralongense* Kristan-Tollmann, 1960, *Variostoma exile* Kristan-Tollmann, 1960, *Lamelliconus ventroplanus* (Oberhauser, 1957), *Ophtalmidium fusiforme* (Trifonova, 1962) and *Pragsoconulus robustus* Oberhauser, 1963. These species are examples of a rich fauna of benthic foraminifera belonging to the *Glomospira kutani* Assemblage Zone.

The biostratigraphic zonation based on benthic foraminifera is not easy to carry out because of their strong facies dependence. Nevertheless, many attempts have been made in the triassic deposits of the Carpatho-Balkans (Salaj et alii, 1983; Trifonova, 1992, 1993) and Transdanubian Central Range (Hungary) (Oravecz-Scheffer, 1987). In particular, as regards the Carnian stage, the *Glomospira kutani* Zone was introduced by Salaj (1969). Apart from the zonal denominator it is characterized by a rich fauna of benthic foraminifera. This Assemblage Zone seems to be of general value because it has many species in common with corresponding Carnian strata in Taurus, Turkey (Altiner & Zaninetti, 1981), West Carpathians (Salaj et alii, 1983), China (He Yan &

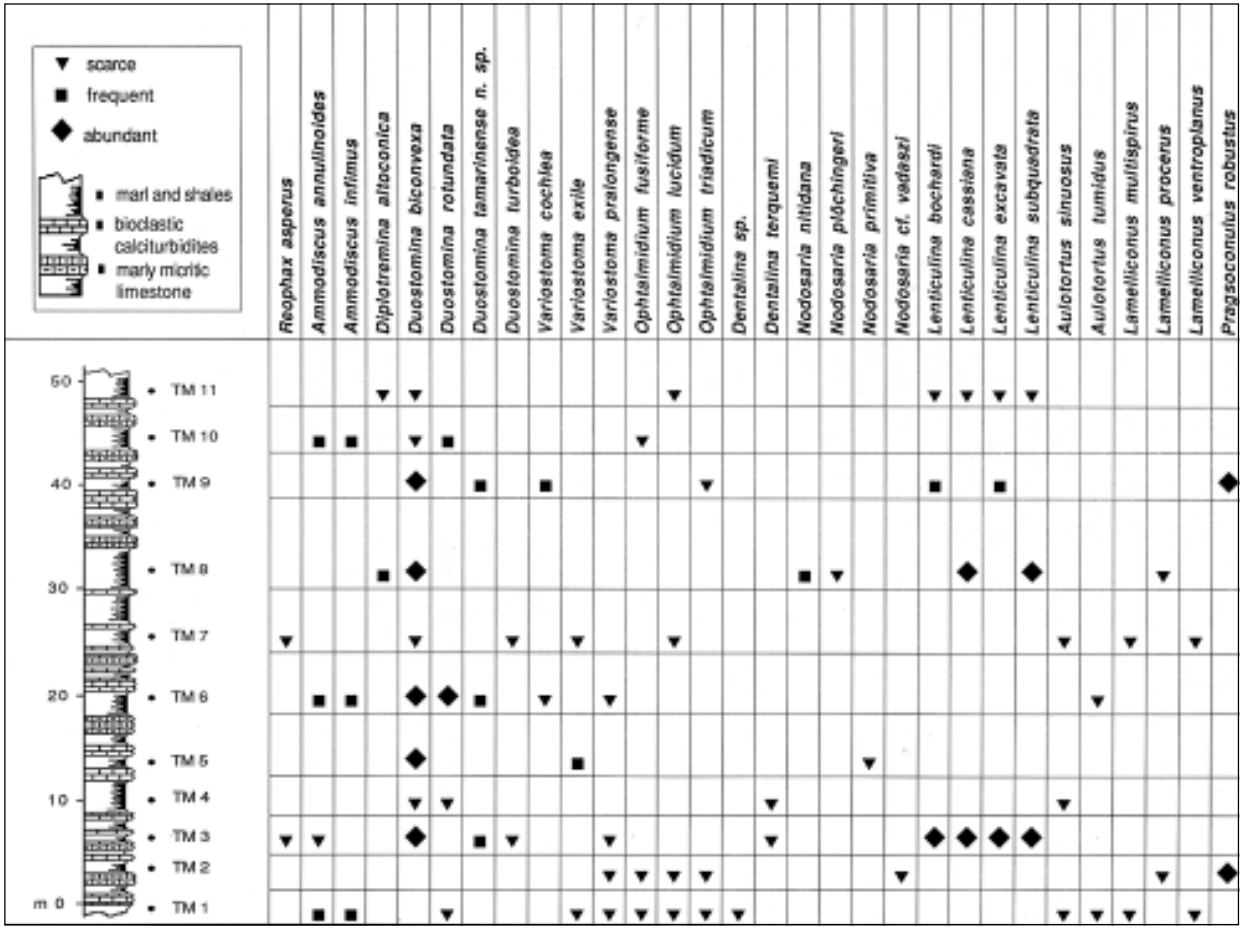


Fig. 2 - Schematic lithologic section of the Tamarin outcrop with distribution of foraminifers.

NORLING, 1991) and the Alps (OBERHAUSER, 1957; KRISTAN-TOLLMANN, 1960, KOEHN-ZANINETTI, 1969, ZANINETTI, 1976). This paper confirms these findings even though we did not find the zonal denominator.

We feel it is important, when using Triassic foraminiferal zonation, to take into consideration the foraminiferal assemblage instead of the single taxon. The first and last occurrence of a benthic foraminifer as well as its acme do not allow an accurate correlation between distant localities because of lateral facies variations. Moreover the age of the foraminiferal assemblage should be based on faunas of higher stratigraphic value such as Ammonoids and Conodonts.

Ammonoid samples that we collected from some laminar marly between TM 4 and TM 5 levels belong to the following species: *Proarcestes* sp., *Megaphyllites jarbas* (Münster), *Pompeckjites philopater* (Laube), *Trachyceras (Trachyceras) infundibuliforme* (Klipstein), *Trachyceras (Trachyceras) saulus* Laube, *Trachyceras* sp. A Urlichs 1994, *Coroceras monilis* (Laube), *Paralobites* sp., *Sirenotrachyceras* sp., *Joannites joannisaustriae* (Klipstein), *Joannites klipsteini* (Müller), *Joannites diffissus* (Hauer). According to URLICHS (1994) this ammonoid fauna characterizes the upper part of the *Aonoides Zone*. It follows that the age of the foraminiferal assemblage studied is certainly Carnian (Cordevolian sensu URLICHS, 1994).

4. TAXONOMIC REMARKS

This paper attempts to adequately describe the foraminiferal assemblage from the biostratigraphic point of view. We have purposely neglected some taxonomic problems encountered because most of them will be dealt with in separate papers. The principal problems involve the suprageneric position of some species.

Pragsoconulus was doubtfully ascribed to the family Involutinidae Bütschli, 1880, by LOEBLICH & TAPPAN (1988) and to the Suborder Textulariina Delage & Herouard, 1896, by VETTOREL (1988), although many architectural and textural characteristics of this genus are still unknown. We have preferred to leave the classification unspecified instead of accepting an hypothetical one.

LOEBLICH & TAPPAN (1988) ascribed the Superfamily Duostominacea Brotzen, 1963 to the Suborder Robertinina in spite of different wall features. The latter Suborder include foraminifers having hyaline, finely perforate ultrastructurally and optically radiate aragonitic lamellar wall, while the duostominid foraminifers have been described as microgranular (KRISTAN-TOLLMANN, 1960; FUCHS, 1975, HOHENEGGER & PILLER, 1975), agglutinated (KRISTAN-TOLLMANN, 1963) or with two layers, an inner radial-fibrous calcitic one and an outer agglutinated one (KOHEN-ZANINETTI, 1969; PREMOLI-SILVA, 1971). Therefore further investigations are necessary to confirm or change such suprageneric assignments.

As regards the species ascribed to the Family Nodosariidae Ehrenberg, 1838, we were not able to study the wall texture both because of a limit supply of samples and a lack of well-preserved material. We have ascribed our species almost entirely to the mainly Mesozoic genera *Nodosaria* and *Dentalina*.

5. Systematic description

Order Foraminiferida D'Orbigny, 1826
Suborder Textulariina Delege & Hérouard, 1896
Superfamily Hormosiniacae Haeckel, 1894
Family Hormosinidae Haeckel, 1894
Subfamily Reophacinae Cushman, 1910
Genus Reophax de Montfort, 1808

Reophax asperus Cushman & Waters, 1928
Pl. 1, Fig. 5

1928 *Reophax asperus* Cushman & Waters, n. sp.; *Cushman & Waters*, 1928; p. 37, pl. 4, fig. 7
1964 *Reophax asperus* Cushman & Waters, 1928; *Kristan-Tollmann*, p. 30, pl. 2, fig. 2.

Remarks - The sutures of the chambers are not easily visible because they are not deeply depressed. The angular grains forming the arenaceous test wall are firmly cemented as the samples described by Cushman & Waters (1928), while Kristan-Tollmann (1964) described samples with few cement. Aperture not visible, probably small and rounded.
Dimensions (in mm) - diameter = 0.45; lenght = 0.9.
Stratigraphic range - Carboniferous-Rhaetian.

Superfamily Ammodiscacea Reuss, 1862
Family Ammodiscidae Reuss, 1862
Subfamily Ammodiscinae Reuss, 1862
Genus Ammodiscus Reuss, 1862

Ammodiscus annulinoides TOLLMANN & KRISTAN-TOLLMANN, 1970
Pl. 1, Fig. 7

1970 *Ammodiscus annulinoides* n. sp., TOLLMANN & KRISTAN-TOLLMANN, p. 119, 120, pl. 3, fig. 6.

Remarks - The samples studied are in agreement with the description of the holotype.
Dimensions (in mm) - the largest diameter = 0.38.
Stratigraphic range - Carnian-Rhaetian.

Ammodiscus infimus (STRICKLAND, 1846)
Pl. 1, Fig. 4

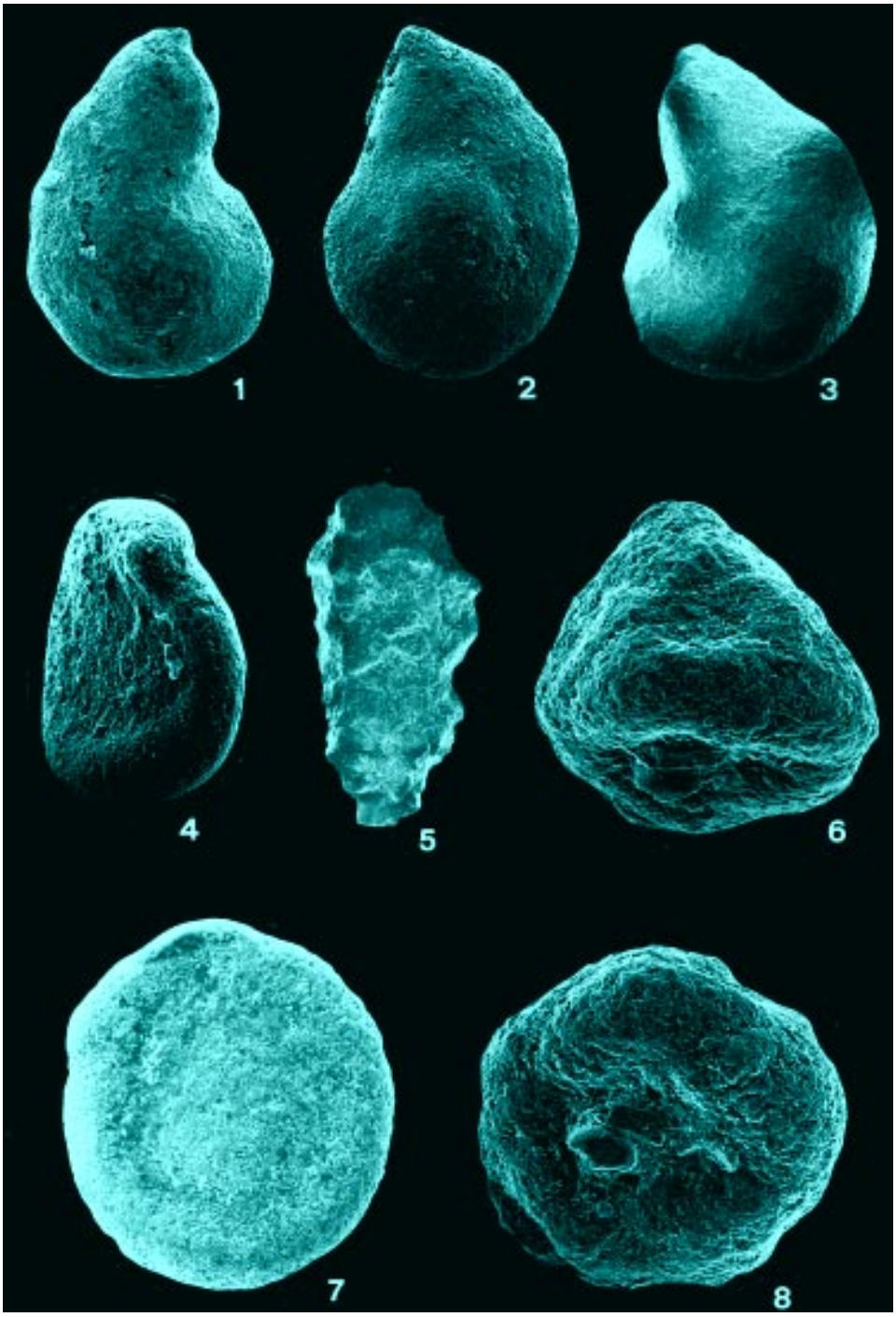
1846 *Orbis infimus* n. sp., Strickland p. 31, pl. a
1964 *Ammodiscus infimus* (STRICKLAND, 1846), *Kristan-Tollmann*, p. 32, pl. 8, figs. 6, 7.

Remarks - The numerous specimens studied are smaller than those described by KRISTAN-TOLLMANN (1964).
Dimensions (in mm) - the largest diameter = 0.3.
Stratigraphic range - Carnian-Lias.

Suborder Robertinina Loeblich & Tappan, 1984
Superfamily Duostominacea Brotzen, 1963
Family Duostominidae Brotzen, 1963
Genus Diplotremina Kristan-Tollmann, 1960

Plate 1

Fig. 1, 3 - *Lenticulina excavata* (Terquem), fig. 1, x64, sample TM 4, fig. 2 x55, sample TM 4;
Fig. 2 - *Lenticulina bochardi* (Terquem), x64, sample TM 4;
Fig. 4 - *Ammodiscus infimus*, x125, sample TM 1,
Fig. 5 - *Reophax asperus* Cushman & Waters, x45, sample TM 4;
Fig. 6, 8 - *Diplotremina altoconica* Kristan-Tollmann, fig. 6 x100, sample TM 1, fig. 8 x110, sample TM 1;
Fig. 7 - *Ammodiscus annulinoides* Tollmann & Kristan-Tollmann, x120 sample TM 1.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Diplotremina altoconica Kristan-Tollmann, 1973
Pl. 1, Fig. 6, 8

1973 *Diplotremina altoconica* n. sp., Kristan-Tollmann, p. 426, pl. 5
1983 *Diplotremina altoconica* Kristan-Tollmann, *Salaj* et alii p. 152, pl. CXXX (partim).

Remarks - Very few specimens belonging to this species have been found in the Tamarin section.
Dimensions (in mm) - largest diameter = 0.38; height = 0.4.
Stratigraphic range - Ladinian-Norian.

Genus *Duostomina* Kristan-Tollmann, 1960

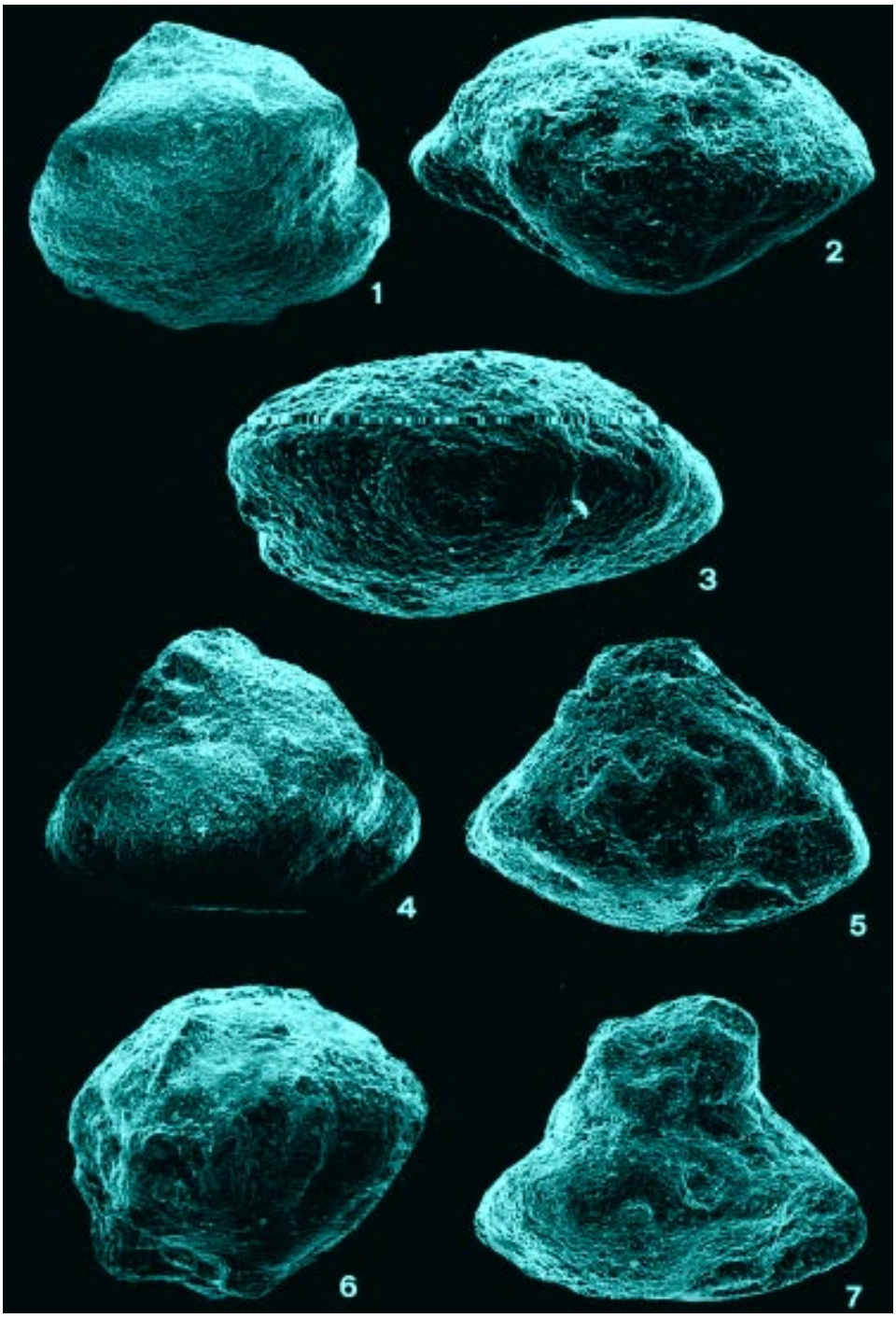
Duostomina biconvexa Kristan-Tollmann, 1960
Pl. 2, Fig. 2

1960 *Duostomina biconvexa* n. sp , Kristan-Tollmann, p.68
1976 *Duostomina biconvexa* Kristan-Tollmann, *Zaninetti* p. 188 (cum syn.), pl. 17, fig. 4; figs. 1, 2
?1988 *Duostomina turboidea* Kristan-Tollmann, *Vettorel* p. 182, pl. 3, fig. 2
1993 *Duostomina biconvexa* Kristan-Tollmann, *Bizzarini* p. 145, 146, pl. 1, figs. 1, 2.

Remarks - *Duostomina biconvexa* is particularly abundant in the Cassian Beds (VETTOREL, 1988; BIZZARINI, 1993) and it is easier recognizable from the isolated material than from thin sections. It is also easily distinguishable from the others species of the genus *Duostomina* because of its typical biconvex shape and little rounded periphery of the test.
Dimensions (in mm) - diameter = 0.35-0.58; height = 0.20-0.35.
Stratigraphic range - Anisian-Carnian.

Plate 2

Fig. 1, 4, 5, 7 - *Duostomina tamarinense* n. sp., fig. 1 x85, sample TM 9, fig. 4 x85, sample TM 9, fig. 5 x100, sample TM 12, fig. 7 x110, sample TM 12;
Fig. 2 - *Duostomina biconvexa* Kristan-Tollmann, x145, sample TM 4;
Fig. 3 - *Duostomina rotundata* Kristan-Tollmann, x210, sample TM 8;
Fig. 6 - *Duostomina turboidea* Kristan-Tollmann, x125, sample TM 4.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Duostomina rotundata Kristan-Tollmann, 1960
Pl. 2, Fig. 3

1960 *Duostomina rotundata* n. gen. n. sp., *Kristan-Tollmann*, pp. 72-73, pl. 20, figs 1-5
1963 *Duostomina rotundata, Kristan-Tollmann* p. 148, pl. 9 (partim)
1964 *Duostomina* cf. *rotundata, Kristan-Tollmann* p. 52, pl. 39, fig. 12
1976 *Duostomina rotundata* Kristan-Tollmann, *Tollmann* p. 286, pl. 170 (partim)
1976 *Duostomina rotundata* Kristan-Tollmann, *Zaninetti* p. 188, pl. 17, fig. 3
1983 *Duostomina rotundata,* Kristan-Tollmann, *Salaj* et alii, p. 153, pl. 134, fig. 7 (non figs 8, 9)
1984 *Duostomina rotundata* Kristan-Tollmann, *Kristan-Tollmann*, p. 272, pl. 13, fig. 8, pl. 135, figs 3, 4.

Remarks - Duostomina rotundata is easily identified because of its lower lenticular test than the other species belonging to the genus *Duostomina*.
Dimensions (in mm) - diameter = 0.20-0.38; height = 0.13-0.20.
Stratigraphic range - Anisian-Rhaetian.

Duostomina tamarinense n. sp.
Pl. 2, Fig. 1, 4, 5, 7

Origin of name: from the name of the locality Tamarin.
Material: 10 specimens from the samples TM 9 and 6 from TM 12;
Holotype: The specimen illustrated in plate 2, fig. 5. The holotype is deposited at the Dipartimento di Scienze della Terra, Università di Modena.
Paratypes: Specimens illustrated in plate 2, figs 1, 4, 7 and others unfigured samples.
Type-locality: Tamarin outcrop, Cortina d'Ampezzo (Belluno), Dolomites, Italy.
Type-level: Upper part of the San Cassiano Fm., Carnian (Cordevolian sensu URLICHS, 1994, *Aonoides Zone*).
Description - Test free, biconvex, dorsal side higher than the opposite umbilical side conical shape; trochospirally coiled, most of chambers visible on the spiral side, only the last whorl visible on the umbonate opposite side, periphery from rounded to subacute. The double interiomarginal aperture is only partially visible. Wall calcareous possibly of hyaline, fine perforate aragonitic lamellae.

Remarks - Duostomina tamarinense n. sp. differs from *Duostomina biconvexa* and *Duostomina turboidea* in having a conical shape and a higher dorsal side. Moreover *Duostomina turboidea* have a very protruding convex umbilical side than *Duostomina tamarinense* n. sp. that have a moderately one.

Dimensions (in mm) - diameter = 0.46-0.60; height = 0.35-0.45.
Stratigraphic range - It is cited here for the first time from Carnian (Cordevolian sensu URLICHS, 1994, *Aonoides Zone*).

Duostomina turboidea Kristan-Tollmann, 1960
Pl. 2, Fig. 6

1960 *Duostomina turboidea* n. gen. n. sp. *Kristan-Tollmann*, p. 71, pl. 18, fig. 4; pl. 19, fig. 5
1963 *Duostomina turboidea* Kristan-Tollmann, *Kristan-Tolmann* p. 148, pl. 9 (partim)
1976 *Duostomina turboidea* Kristan-Tollmann, *Zaninetti* p. 189, pl. 17, fig. 1
1983 *Duostomina turboidea* Kristan-Tollmann, *Salaj* et alii p. 153, 154, pl. CXXXIII, figs. 1-3, pl. CXXXV, figs 5, 6.

Remarks - In spite of the studied samples are not completely preserved they are ascribed to this species for the typical protruding umbilical side.
Dimensions (in mm) - diameter = 0.38; height = 0.31.
Stratigraphic range - Carnian-Rhaetian.

Genus *Variostoma* Kristan-Tollmann, 1960

Variostoma cochlea Kristan-Tollmann, 1960
Pl. 3, Fig. 7-9

1960 *Variostoma cochlea* n. gen. n. sp. - *Kristan-Tollmann*, p. 63, pl. 13, figgs 1, 5, 7, 8; pl. 14, fig. 5
1963 *Variostoma cochlea* - *Kristan-Tollmann*, p. 148, pl. 9 (partim)
1976 *Variostoma cochlea* - *Zaninetti*, p. 189, pl. 16, fig. 4.

Remarks - Some characters of *Variostoma cochlea* are similar to *Variostoma pralongense,* but it differs because of the larger apical part of the cone and a different umbilical area. The calcareous lamella described by KRISTAN-TOLLMANN (1960) are not present in our specimens probably because of its easy broken.
Dimensions (in mm) - largest diameter = 0.24-0.55; height = 0.28-0.40.
Stratigraphic range - Carnian-Rhaetian.

Variostoma exile Kristan-Tollmann, 1960
Pl. 3, Fig. 1, 3

1960 *Variostoma exile* n. g. n. sp. - *Kristan-Tollmann*, p. 58, pl. 8, fig. 5, pl. 9, figs. 4-8
1963 *Variostoma exile* Kristan-Tollmann, *Kristan-Tollmann* p. 148, pl. 9 (partim)
1975 *Variostoma exile* Kristan-Tollmann, *Fuchs*, pl. 2, fig. 1, pl. 3, figs 3, 4
1976 *Variostoma exile* Kristan-Tollmann, *Tollmann*, p. 138, pl. 58, figs 3, 4
1976 *Variostoma exile* Kristan-Tollmann, Zaninetti, p. 190, pl. 16, fig. 7
1979 *Variostoma exile* Kristan-Tollmann, *Resch* p. 230, pl. 5, fig. 30
1988 *Variostoma oberhauseri Vettorel*, p. 170-171, pl. 1, figs 4, 5
1988 *Variostoma exile Vettorel*, p. 165-168, pl. 1, fig. 7.

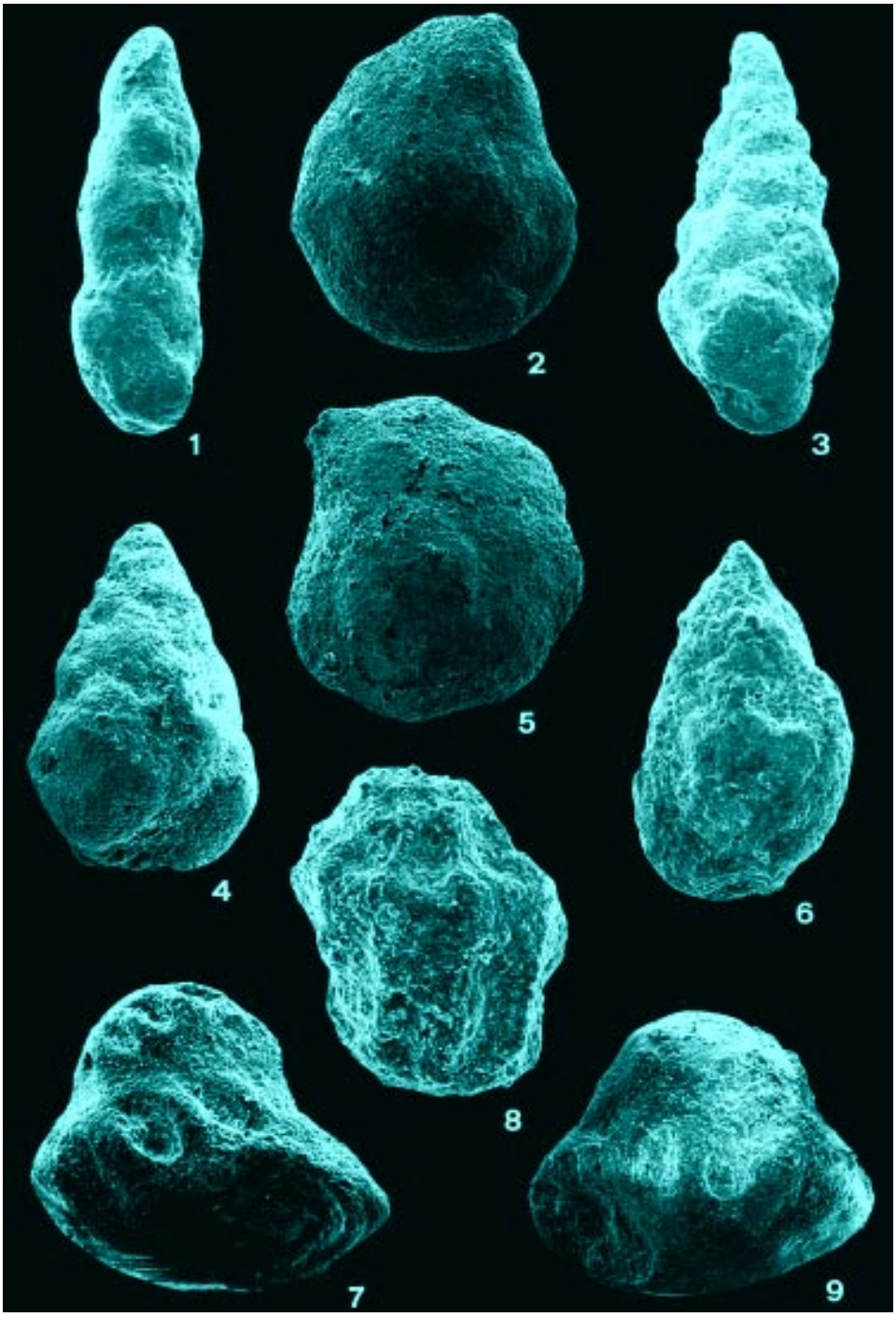
Remarks - This is the slenderest species of the genus *Variostoma.* Some of the studied samples (Pl. 3, fig. 1) have a very low value of the largest diameter of the test. It is lower than the value given by KRISTAN-TOLLMANN (1960) and VETTOREL (1988).
Dimensions (in mm) - largest diameter = 0.16-0.30; height = 0.5-0.7.
Stratigraphic range - Carnian.

Variostoma pralongense Kristan-Tollmann, 1960
Pl. 3, Figs 4, 6

1960 *Variostoma pralongense* n. g. n. sp. - *Kristan-Tollmann*, p. 57-58, pl. 8 figs. 2-4, pl. 9, figs 1-3
1963 *Variostoma pralongense* Kristan-Tollmann, *Kristan-Tollmann*, pl. 9 (partim)
1975 *Variostoma pralongense* Kristan-Tollmann, *Fuchs*, pl. 1, figs 5, 6
1976 *Variostoma pralongense* Kristan-Tollmann, *Tollmann* & *Kristan-Tollmann*, p. 138, pl. 58, figs 1, 2

Plate 3

Fig. 1, 3 - *Variostoma exile* Kristan-Tollmann, fig. 1, x110, sample TM 1, fig. 2 x75, sample TM 1;
Fig. 2 - *Lenticulina cassiana* (Gümbel), x55, sample TM 4;
Fig. 4, 6 - *Variostoma pralongense* Kristan-Tollmann, fig. 4 x95, sample TM 1, fig. 6 x125, sample TM 3;
Fig. 5 - *Lenticulina subquadrata* (Terquem), x70, sample TM 4;
Fig. 7, 8, 9 - *Variostoma cochlea* Kristan-Tollmann, fig. 7 x100, sample TM 12, fig. 8 x150, sample TM 9, fig. 9 x105, sample TM 12.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1976 *Variostoma pralongense* Kristan-Tollmann, *Zaninetti*, p. 190, pl. 16, fig. 6
1983 *Variostoma pralongense* Kristan-Tollmann, *Salaj* et al., p. 155, pl. 138, fig. 4, pl. 139, figs 3, 4
1988 *Variostoma pralongense* Kristan-Tollmann, *Vettorel*, p. 164-165, pl. 1, figs 1, 2, 12, 13.

Remarks - This species is always associate with *Variostoma exile* from which differs in having a wider size and a bigger umbilical area. VETTOREL (1988) pointed out the differences between this two species by elaboration of biometrics data.
Dimensions (in mm) - largest diameter = 0.20-0.40; height = 0.36-0.60.
Stratigraphic range - Carnian.

Suborder Miliolina Delage & Hérouard, 1896
Superfamily Cornuspiracea Schultze, 1854
Family Ophthalmidiidae Wiesner, 1920
Subfamily Ophthalmidinae Wiesner, 1920
Genus Ophthalmidium Kubler & Zwingli, 1870

Ophtalmidium fusiforme (Trifonova, 1962)
Pl. 4, Fig. 5

1962 *Spirophtalmidium fusiforme* n. sp. *Trifonova*, p. 157, pl. 4, fig. 6
1976 *Ophtalmidium fusiforme* (Trifonova), *Zaninetti*, p. 144 (not figured)
1993 *Ophtalmidium fusiforme* (Trifonova) *Trifonova*, p. 54, pl. 10, figs 15, 16 (*cum syn.*).

Remarks - This species is always associated with *Ophtalmidium lucidum* from which differs for the tapering peripheral outline.
Dimensions (in mm) - Length = 0.35-0.47; greatest breadth = 0.15-0.20.
Stratigraphic range - Carnian-Norian.

Ophtalmidium lucidum (Trifonova, 1962)
Pl. 4, Fig. 7

1962 *Spirophtalmidium lucidum* n. sp., *Trifonova*, p. 157, pl. 4, figs 4, 5
1976 *Ophtalmidium lucidum* (Trifonova), *Zaninetti*, p. 145 (not figured)
1993 *Ophtalmidium lucidum* (Trifonova), *Trifonova*, p. 54, pl. 10, figs 17, 18 (*cum syn.*).

Remarks - The specimens ascribed to this species are very abundant and preserved.
Dimensions (in mm) - Length = 0.45-0.72; greatest breadth = 0.28-0.53.
Stratigraphic range - Carnian-Rhaetian.

Ophthalmidium triadicum (Kristan-Tollmann, 1957)
Pl. 4, Fig. 6

1957 *Spirophtalmidium triadicum* n. sp., *Kristan-Tollmann*, p. 290, pl. 25, fig. 2-4
1993 *Ophthalmidium triadicum* (Kristan-Tollmann), *Trifonova*, p. 55, pl. 8, fig. 26 (*cum syn.*).

Remarks - The studied specimens have smaller dimension than the specimens described by KRISTAN-TOLLMANN (1957).
Dimensions (in mm) - Length = 0.42; greatest breadth = 0.21.
Stratigraphic range - Carnian-Rhaetian.

Suborder Lagenina Delege & Hérouard, 1896
Superfamily Nodosariacea Ehrenberg, 1838
Family Nodosariidae Ehrenberg, 1838
Subfamily NODOSARIINAE Ehrenberg, 1838
Genus Dentalina Risso, 1926

Dentalina terquemi d'Orbigny, 1849
Pl. 4, Fig. 1

1849 *Dentalina terquemi* n. sp., *d'Orbigny*, p. 241, n. 247 (fide Heath & Apthorpe, 1986)
1955 *Dentalina terquemi* d'Orbigny, *Tappan*, p. 66, pl. 23, figs 1-4
1964 *Dentalina terquemi* d'Orbigny, *Kristan-Tollmann*, p. 96, pl. 15, figs 12-15; pl. 17, fig. 18
1976 *Dentalina terquemi* d'Orbigny, *Nicora & Premoli-Silva*, p. 492, pl. 1, fig. 5
1986 *Dentalina terquemi* d'Orbigny, *Heath & Apthorpe*, p. 319, pl. 1, figs 21-23.

Remarks - Triassic records of this species include the Anisian of Chios Island (Greece) by NICORA & PREMOLI-SILVA (1976), of Western Australia by HEATH & APTHORPE (1986) and the Norian-Rhaetian of Austria by KRISTAN-TOLLMANN (1964).

Dimension (in mm) - largest diameter = 0.18; height = 0.95.
Stratigraphic range - Middle Triassic (Anisian)-Early Jurassic (Toarcian).

Dentalina sp.
Pl. 4, Fig. 2

Remarks - This species is represented by a single small specimen.

Genus Nodosaria Lamark, 1812

Nodosaria nitidana Brand, 1937
Pl. 4, Fig. 9, 10

1964 *Nodosaria nitidana* Brand, *Kristan-Tollmann*, p.67, pl. 10, figs 1-4 (*cum syn.*)
1983 *Nodosaria nitidana* Brand, *Salaj* et alii p. 118, pl. 80, fig. 7.

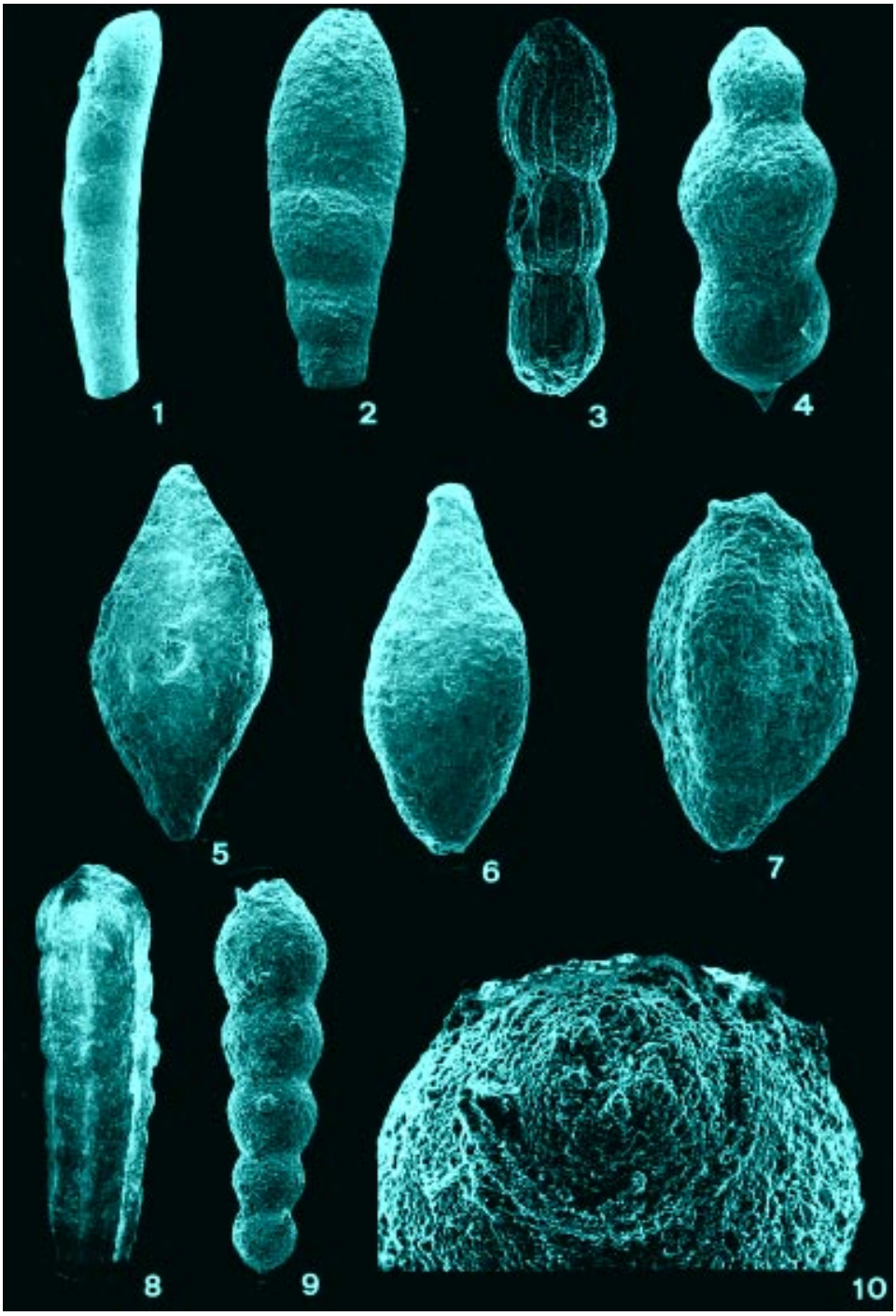
Remarks - Test morphology of the studied specimens resembles the species described by KRISTAN-TOLLMANN in 1964. Some samples show the typical radiate aperture.
Dimension (in mm) - largest diameter = 0.3; height = 1.1.
Stratigraphic range - Late Triassic (Carnian)-Lias.

Nodosaria plöchingeri (Oberhauser, 1960)
Pl. 4, Fig. 8

1960 *Pseudoglandulina plöchingeri* n. sp., *Oberhauser* pp. 27- 28, pl. 1, figs 1-41
1986 *Nodosaria plöchingeri (*Oberhauser), *Hearth* & *Apthorpe* p. 317, pl. 1, figs 15, 16 (*cum syn.*).

Plate 4

Fig. 1 - *Dentalina terquemi*, x55, sample TM 4;
Fig. 2 - *Dentalina* sp., x55, sample TM 1;
Fig. 3 - *Nodosaria* cf. *vadaszi*, x100, sample TM 2;
Fig. 4 - *Nodosaria primitiva*, x100, sample TM 8;
Fig. 5 - *Ophtalmidium fusiforme* (Trifonova), x110, sample TM 3;
Fig. 6 - *Ophtalmidium triadicum* (Kristan-Tollmann), x100 sample TM 3;
Fig. 7 - *Ophtalmidium lucidum* (Trifonova), x100, sample TM 1;
Fig. 8 - *Nodosaria plöchingeri* (Oberhauser), x90, sample TM 8
Fig. 9, 10 - *Nodosaria nitidana* Brand, fig. 9 x45, sample TM 11, fig. 10 x200, sample TM 11.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Remarks - The few analyzed specimens consist of incomplete fragments characterized by six seven low broad and gently tapering chamber with longitudinal ribs.
Dimension (in mm) - largest diameter = 0.14; height = 0.6.
Stratigraphic range - Anisian-Carnian.

Nodosaria primitiva Kübler und Zwingli
Pl. 4, Fig. 4

1936 *Nodosaria primitiva,* Franke, pl. 4, fig. 4 (fide *Oberhauser*, 1960)
1960 *Nodosaria primitiva, Oberhauser*, p. 25, pl. 6, figs 4, 5.

Remarks - Very few specimens belonging to this species have been found in the Tamarin section.
Dimension (in mm) - largest diameter = 0.2; height = 0.5.
Stratigraphic range - Carnian, Lias.

Nodosaria cf. *vadaszi* (Oberhauser, 1960)
Pl. 4, Fig. 3

1960 *Dentalina vadaszi* n. sp., *Oberhauser* p. 23, pl. 3, figs 11, 17, pl. 4, fig. 34
1986 *Nodosaria vadaszi* (Oberhauser, 1960), *Heath* & *Apthorpe*, p. 319, pl. 1, figs. 17, 18.

Remarks - This species differs from other striate species of *Nodosaria* by the absence of ribbing on the proloculus. Unfortunately the studied samples does not show clearly this character.
Dimension (in mm) - largest diameter = 0.15; height = 0.47;
Stratigraphic range - Anisian, Carnian.

Family Vaginulinidae Reuss, 1860
Subfamily Lenticulininae Chapman, Parr & Collins, 1934
Genus Lenticulina Lamark, 1804

Lenticulina bochardi (Terquem, 1864)
Pl. 1, Fig. 2

1864 *Cristellaria bochardi*, Terquem p. 419, pl. 10, fig. 3a-c (fide *Kristan-Tollmann*, 1964)
1964 *Lenticulina (Lenticulina) bochardi* (Terquem), *Kristan-Tollmann* p. 1, 9-110, pl. 20, figs 1-3, pl. 22, fig. 9.

Remarks - The specimens referred to this species are relatively abundant and well preserved. They have a smaller size than the Rhaetian specimens described by KRISTAN-TOLLMANN (1964);
Dimension (in mm) - largest diameter = 0.5.
Stratigraphic range - Late Triassic (Carnian, Rhaetian)- Lias.

Lenticulina cassiana (Gümbel, 1869)
Pl. 3, Fig. 2

1869 *Cristellaria cassiana* n. sp., *Gümbel*, p. 177, pl. 5, figs 2, 3.

Remarks - The specimens ascribed to this species are very abundant and well preserved. Some of the samples studied have a gently angled periphery than a typical rounded one that resemble *Lenticulina polygonata* Franke. Nevertheless *Lenticulina cassiana* have a thinner thickness periphery than *Lenticulina polygonata*.
Dimensions (in mm) - largest diameter = 0.65-0.8.
Stratigraphic range - Carnian.

Lenticulina excavata (Terquem, 1864)
Pl. 1, Fig. 1, 3

1864 *Cristellaria excavata* n. sp., Terquem p. 446, pl. 16, figs. 30a-b (fide *Kristan-Tollmann*, 1964)
1964 *Lenticulina (Lenticulina) excavata* (Terquem), *Kristan-Tollmann* p. 110-111, pl. 20, fig. 6, pl. 21, figs 6, 7
1983 *Lenticulina (Lenticulina) excavata* (Terquem), *Salaj* et alii p. 123, pl. 146, fig. 11.

Remarks - The studied samples are smaller than those described by KRISTAN-TOLLMANN. They are more similar to the species described as *Lenticulina excavata* by SALAJ et alii (1983).

Dimension (in mm) - largest diameter = 0.5-0.7.
Stratigraphic range - Late Triassic (Carnian, Rhaetian)- Lias.

Lenticulina subquadrata (Terquem, 1862)
Pl. 3, Fig. 5

1862 *Cristellaria subquadrata,* Terquem p. 448, pl. 6, figs 7a-b (fide *Kristan-Tollmann*, 1964)
1964 *Lenticulina (Lenticulina) subquadrata* (Terquem), *Kristan-Tollmann* p. 109, pl. 19, figs. 1, 2, 13; pl. 20, fig. 7
1983 *Lenticulina (Lenticulina) excavata* (Terquem), *Salaj* et alii p. 123, pl. 81, fig. 11.

Remarks - Most of the studied specimens are smaller than the Anisian one described by SALAJ et alii (1983). They have the same size of the Rhaetian specimens described by KRISTAN-TOLLMANN (1964);
Dimension (in mm) - diameter = 0.5.
Stratigraphic range - Triassic (Anisian, Carnian, Rhaetian) - Lias.

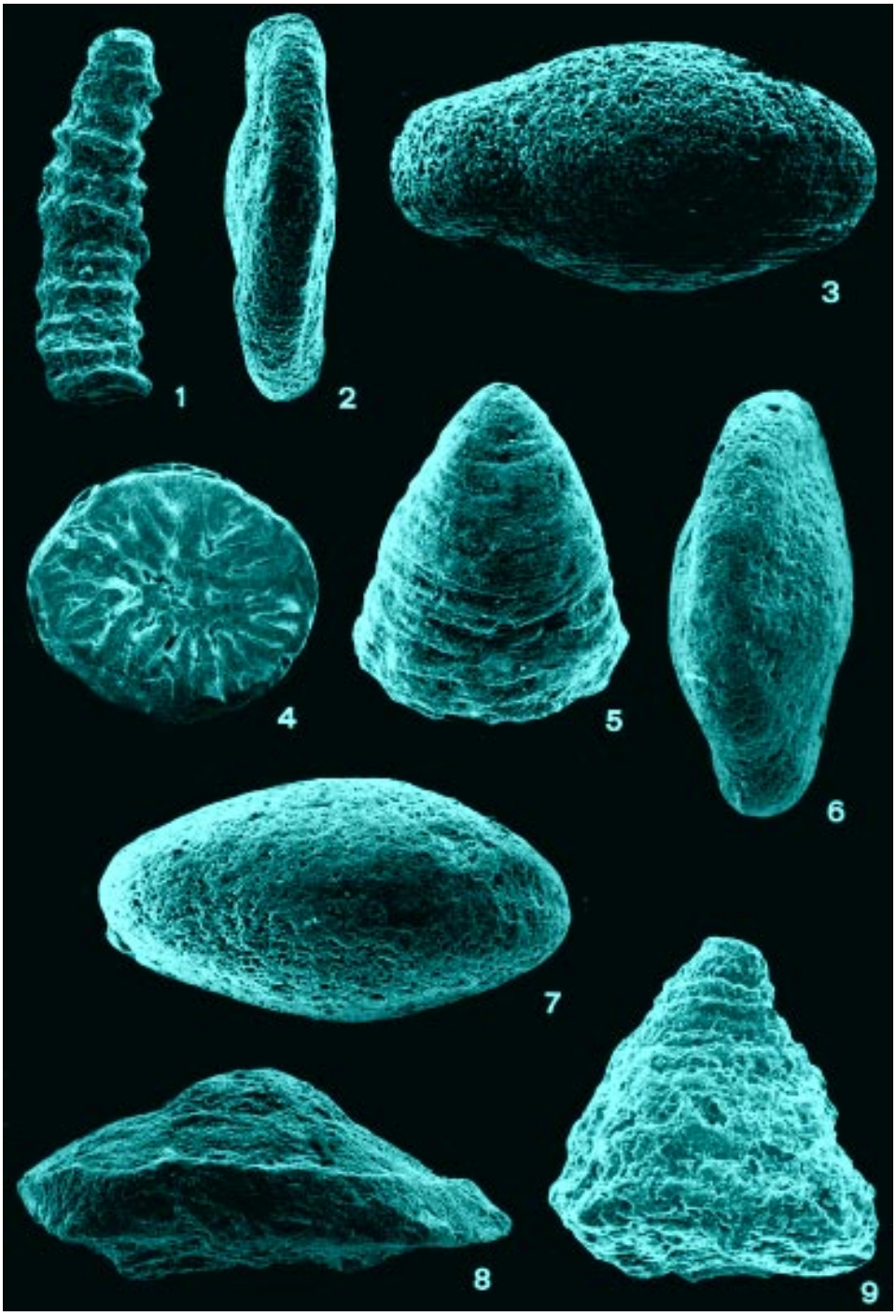
Suborder Involutinina Hohenegger & Piller, 1977
Family Aulotortidae Zaninetti, 1984
Subfamily Aulotortinae Zaninetti
Genus Aulotortus Weynschenk, 1956

Aulotortus sinuosus Weynschenk, 1956
Pl. 5, Fig. 3, 6, 7

1956 *Aulotortus sinuosus* n. sp., *Weynschenk*, p. 27, figs. 1, 2, pl. 6, figs. 1-3
1994 *Aulotortus sinuosus* Weynschenk, di *Bari & Laghi*, p. 106-108, fig. 8, pls. 1, 2 (*cum syn.*).

Plate 5

Fig. 1 - *Lamelliconus procerus* (Liebus), x75, sample TM 3;
Fig. 2 - *Aulotortus tumidus* (Kristan-Tollmann), x130, sample TM 1;
Fig. 3, 6, 7 - *Aulotortus sinuosus* Weynschenk, fig. 3 x165, sample TM 1, fig. 6 x165, sample TM 1, fig. 7 x135, sample TM 1;
Fig. 4, 5 - *Pragsoconulus robustus* Oberhauser, fig. 4 x25, sample TM 9, fig. 5 x23, sample TM 2;
Fig. 8 - *Lamelliconus ventroplanus* (Oberhauser), x135, sample TM 1;
Fig. 9 - *Lamelliconus multispirus* (Oberhauser), x155, sample TM 1.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Remarks - The specimens belonging to this species are unfortunately poor preserved, nevertheless some typical characters have been allowed to refer the studied samples to this species: lenticular shape of the test, rounded periphery and oscillating enrollment of the last whorls (Fig. 3)
Dimensions (in mm) - diameter = 0.44; height = 0.23.
Stratigraphic range - Anisian-Rhaetian.

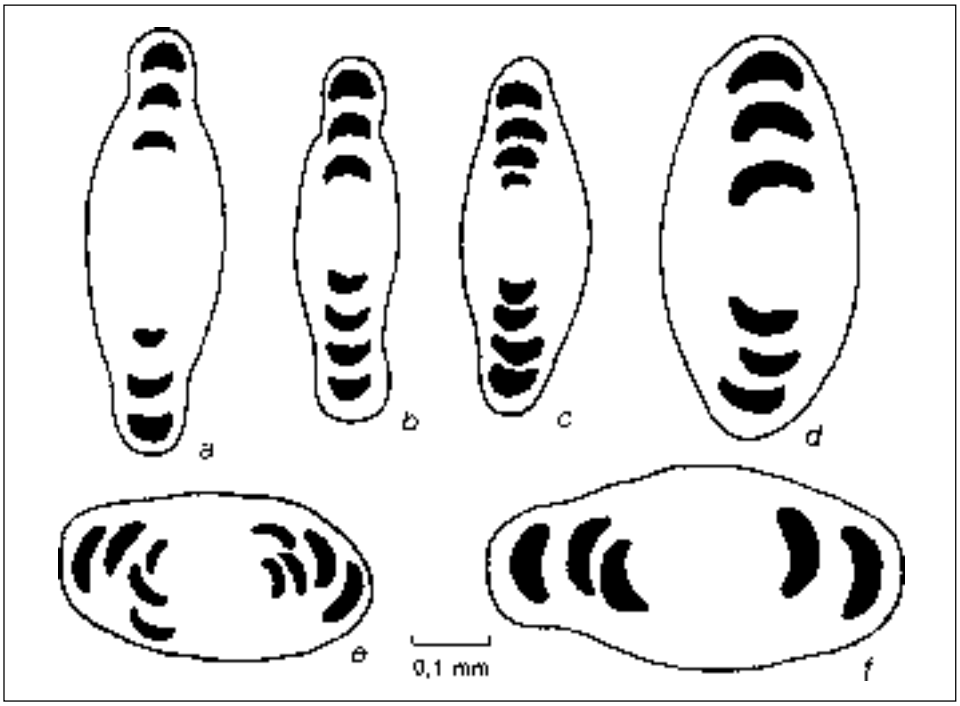

Fig. 3 - a, b, c, *Aulotortus tumidus* (Kristan-Tollmann); d, e, f, *Aulotortus sinuosus* Weynschenk.

Aulotortus tumidus (Kristan-Tollmann, 1964)
Pl. 5, Fig. 2

1964 *Angulodiscus tumidus* n. sp., *Kristan-Tollmann*, p. 141, pl. 3, figs 1-6
1978 *Aulotortus tumidus* (Kristan-Tollmann), *Piller*, p. 51-55, pl. 6, figs 1-8, pl. 7, figs 1-16 (*cum syn.*).

Remarks - The main differences of *Aulotortus tumidus* from *Aulotortus sinuosus* are the more flattened shape in axial section (Fig. 3) and the 2/3 evolute whorls

of the last stage of the enrollment. Unfortunately in the studied samples the first stage of the enrollment are not visible.
Dimensions (in mm) - diameter = 0.36; height = 0.11.
Stratigraphic range - Carnian-Rhaetian, ?Lias.

Family Triadodiscidae Zaninetti, 1984
Subfamily Lamelliconinae Zaninetti, Ciarapica, Decrouez & Martini, 1984
Genus Lamelliconus Piller, 1978

Lamelliconus multispirus (Oberhauser, 1957)
Pl. 5, Fig. 9

1957 *Trocholina (Trocholina) multispira,* n. sp., *Oberhauser*, p. 259, pl. 20, figs 1-14
1988 *Lamelliconus multispirus* (Oberhauser), *Vettorel*, p. 188-189, pl. 3, figs 7, 8
1988 *Lamelliconus ventroplanus* (Oberhauser), *Vettorel*, p. 189-192, pl. 3, fig. 6
1995 *Lamelliconus multispirus* (Oberhauser), *Rettori*, p. 84, pl. 13, figs 1, 3, 4, 9, 10, (*cum syn.*).

Remarks - Lamelliconus multispirus differs from the others species belonging to the genus *Lamelliconus* in having a breadth apical angle. It is more obtuse than *Lamelliconus ventroplanus*, and *Lamelliconus biconvexus*. The main differences from *Lamelliconus procerus* are the following: shape of the cone, less whorls of the second chamber and increase of the distance among the lumina from the top to the base of the cone.
Dimensions (in mm) - largest diameter = 0.23; height = 0.29.
Stratigraphic range - Anisian-Carnian.

Lamelliconus procerus (Liebus, 1942)
Pl. 5, Fig. 1

1942 *Turritelella procera* n. sp., *Liebus*, pl. 3, figs 2b-d, non text-fig. 1(a, b)
1995 *Lamelliconus procerus* (Liebus), *Rettori*, p. 86, 87, pl. 13, figs 2, 5, 6 (*cum syn.*).

Remarks - Lamelliconus procerus distinguish itself from the others species of the genus *Lamelliconus* by its height of the cone that sometimes can approach a

cylindrical shape and height number of the whorls. In the others species of *Lamelliconus* the base of the cone become larger.
Dimensions (in mm) - height = 0.6; the largest diameter = 0.18.
Stratigraphic range - Ladinian-Carnian.

Lamelliconus ventroplanus (Oberhauser, 1957)
Pl. 5, Fig. 8

1957 *Trocholina (Trocholina) ventroplana,* n. sp., *Oberhauser*, p. 262, pl. 20, figs 15-23
1976 *Trocholina ventroplana* Oberhauser, *Zaninetti*, p. 181, pl. 10, figs 19, 20 (*cum syn.*)
1983 *Lamelliconus ventroplanus* (Oberhauser), *Salaj* et alii p. 148, fig. 2
1988 *Lamelliconus ventroplanus* (Oberhauser), *Vettorel*, p. 189-192, pl. 3, figs 4, 5, non fig. 6.

Remarks - Lamelliconus ventroplanus has a typical flat umbilical region that differ from *Lamelliconus biconvexus* having a convex one. Nevertheless sometimes to distinguish this two species can be difficult because of forms having a transitional convexity value of the umbilical region (SALVINI-BONNARD & ZANINETTI, 1989; ZAMPARELLI, 1991). For this reason RETTORI (1995) put together in a group the above quoted species. Nevertheless we think it right to do a statistical study to estimate the real variability of umbilical convexity before to put together this two species.
Dimensions (in mm) - largest diameter = 0.47; height = 0.19.
Stratigraphic range - Ladinian-Carnian.

Suborder Incerta sedis
Family Incerta sedis
Genus Pragsoconulus Oberhauser, 1963

Pragsoconulus robustus Oberhauser, 1963
Pl. 5, Fig. 4, 5

1963 *Pragsoconulus robustus* n. g. n. sp., *Oberhauser* pp. 29-33, Figs 1, 2
1976 *Pragsoconulus robustus* Oberhauser, *Zaninetti* p. 118, pl. 22, figs 11, 12
1988 *Pragsoconulus robustus* Oberhauser, *Vettorel* pp. 185-186, tavv. 4, 5.

Remarks - Although LOEBLICH & TAPPAN (1988) ascribed *Pragsoconulus* doubtfully to the family Involutinidae Bütschli, 1880, subfamily Aulotortinae Zaninetti, 1984 and VETTOREL (1988) to the Suborder Textulariina Delage & Herouard, 1896, Family *incerta sedis* we think their exact soprageneric position is still uncertain because many architectural and textural characteristics are still unknown.
Dimensions (in mm) - height = 2-3; the largest diameter = 1-2.
Stratigraphic range - Ladinian-Carnian.

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