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Ammonite biostratigraphy of some Mediterranean sections. 2: The succession of the Gola del F. Burano (Umbria-Machigiano Basin, Apennine), a reference section for Tethyan Domain

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Abstract
This study (second part of five articles) is dedicated to the ammonites of the Upper Pliensbachian (Domerian) of the Gola del F. Burano section (Umbria-Marche Apennines). A careful systematic description of 68 taxa belonging to the Phylloceratidae, Juraphyllitidae, Lytoceratidae, Phricodoceratidae, Liparoceratidae, Dubariceratidae, Dactylioceratidae and Hildoceratidae led to the construction of a detailed biostratigraphical framework for almost the whole Domerian. We also attempt to clarify the taxonomy of some important marker species, in particular the Early Domerian Harpoceratinae like *Fuciniceras ambiguum* (FUCINI), *Fuciniceras lavinianum* (FUCINI) and *Fuciniceras isseli* (FUCINI). Excepted the presence of *Pleuroceras solare* (PHILLIPS), all the species show strict Tethyan paleogeographical affinities.

Key-words
Domerian (Upper Pliensbachian), Mediterranean Province, Umbria-Marche Succession, Ammonites, Taxonomy.

INTRODUCTION

The Umbria-Marche area can be considered a classic fossiliferous locality for Early Jurassic and Late Jurassic-Early Cretaceous ammonites. During the 19th and the first years of the 20th centuries MENEGHINI (1867-1881), ZITTEL (1869), CANAVARI (1896-1903), BONARELLI (1899), FUCINI (1899-1900) amongst others, published important monographs. Their works are still landmarks since many type fossils were described. In the following years the paleontological studies based on invertebrate fossils decreased in number. This was mainly due to the facts of the two wars but one may think that those papers accomplished a phase of exploration that was considered completed. In spite of that, a real biostratigraphical framework was totally missing as the fossils were collected without serious Stratigraphical criteria. During the 80's and the 90's, the works of CECCA *et al.* (1990, 1995, 1998) shed more light on the Late Jurassic-Early Cretaceous ammonites and allowed us to know the exact Stratigraphical position of many species typical of this span of time instituted by the classic authors.
The Lower Jurassic rocks of the same area did not experience the same attention, since sampling was generally concentrated in small outcrops and/or based on a limited number of specimens. It must also be said that the Lower Jurassic more complete successions of the Umbria-Marche area, are notably more expanded than the Upper Jurassic-Lower Cretaceous ones. Fossils are normally more diluted in the 'Liassic' Stratigraphical successions. There is greater probability that their continuity is interrupted by faults and/or covered by vegetation. The most important contributions to the knowledge of the Lower Jurassic ammonite biostratigraphy in the Umbria-Marche area were given by FERRETTI (1970, 1972, 1975), VENTURI (1978), PALLINI (1986), CECCA *et al.* (1987), FARAONI *et al.* (1994), DOMMERGUES *et al.* (1990), VENTURI & FERRI (2001) and VENTURI & NANNARONE (2003).

THE STUDIED OUTCROP

The Gola del Fiume Burano Section is located in the north east part of the Internal Anticlinorium of the Umbria-Marche Stratigraphical-Structural Domain. This is a fold and thrust belt composed of carbonate and terrigenous sediments, Triassic-Neogenic in age. The reader is reminded to the works of LAVECCHIA *et al.* (1989) and SANTANTONIO (1994), with references

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therein, for more detailed and complete discussions on the tectonic and stratigraphy of Umbria-Marche Domain.

The Burano Gorge Section (BCF; Fig. 1) is localised in the Burano Gorge, between the villages of Cantiano and Cagli (PU). It is located an abandoned quarry named Cave di Pietra, at approximately 425 m of altitude in the right side of the Burano River, fifty meters in altitude approximately above the Cave di Pietra tunnel of the S.S. 3 Flaminia.

The succession (Figs 2-8ab) was investigated for 18,50 metres approximately, where the most part (17,50 m) are Domerian in age. The major part of the succession pertains to the Corniola Until, which is composed of decimetric limestones (20-30 cm thick in average) red coloured until the metre 15,00 and after white. All that are prevalently mudstones but some wackestones, rich in crinoids articles and ammonites, occur in the lower F. lavinianum Zone. These hard pseudonodular to nodular layers represent a lithofacies of Rosso Ammonitico corresponding to the upper Carixian-lower Domerian Sphinctozoa beds of PALLINI & SCHIAVINOTTO (1981). Above the metre 15,00 the white limestones are slighly enriched in marl and tend to be subdived in large nodules. The upper portion of the lithologic successions pertains to the Marne di M. Serrone Formation, and is composed of grey-green marls sometimes rich in calcareous nodules. The last two outcropping beds are grey marly limestones, correlating with the Bosso section (FARAONI *et al.*, 1994a), and the Migiana di M. Malbe section (MACCHIONI 2001, 2002b) they are probably the last two calcareous beds before the Early Toarcian Anoxic Event.

PREVIOUS STUDIES

The section is already known in literature for the works of DOMMERGUES *et al.* (1983, 1990), both were concentrated in the fauna of the lower F. lavinianum Zone. In the prior the authors deal with paleobiogeographical and faunal correlation between lower Domerian ammonites faunas of Umbria-Marche Apennines and Upper Australpine of Hungary. The second paper was principally focused in some problematic regarding functional morphology and taxonomic nomenclature of the genera *Fuciniceras* and *Protogrammoceras*.

Fig. 1: Tectono-Stratigraphical sketch maps of the study area.

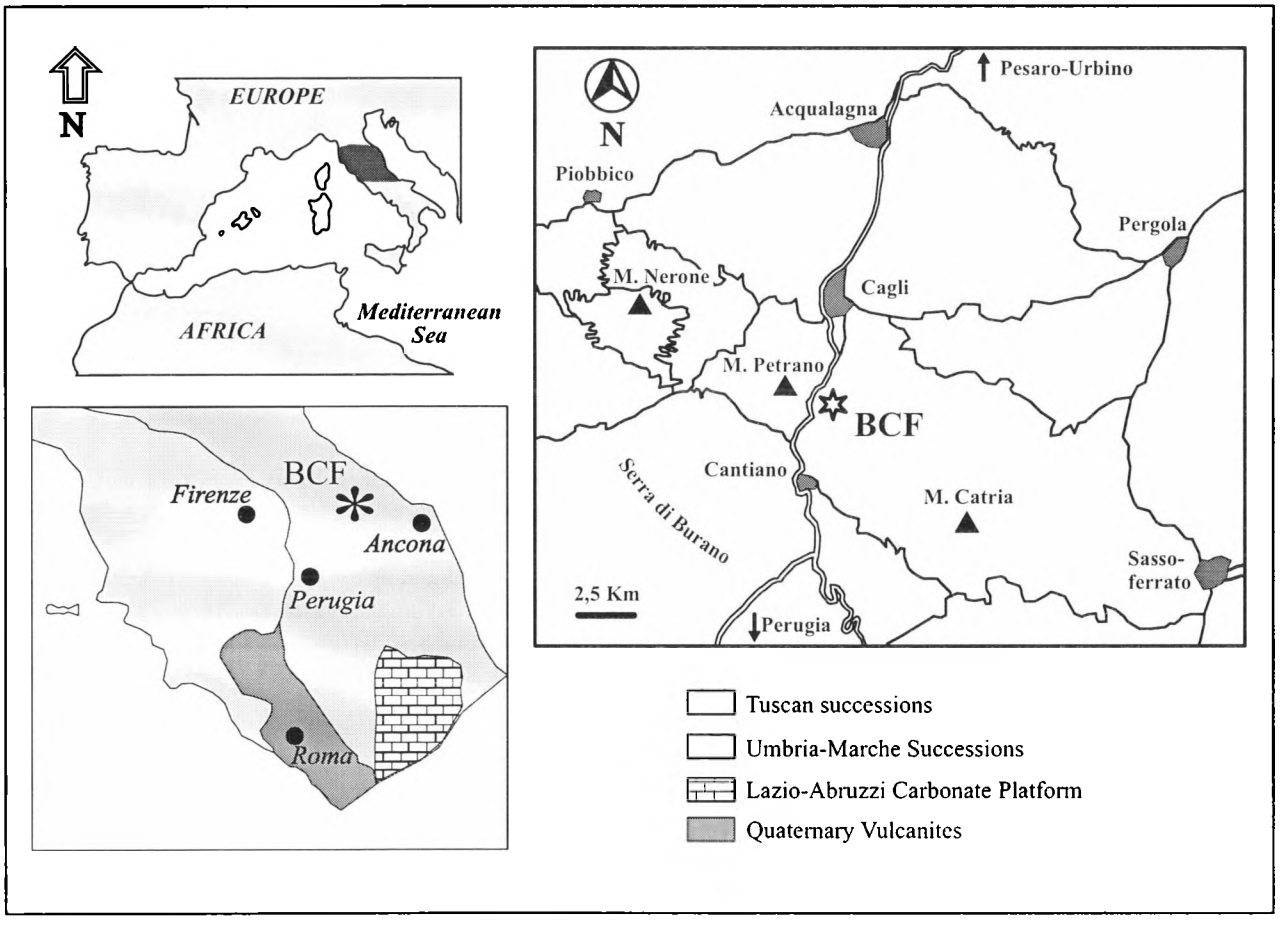
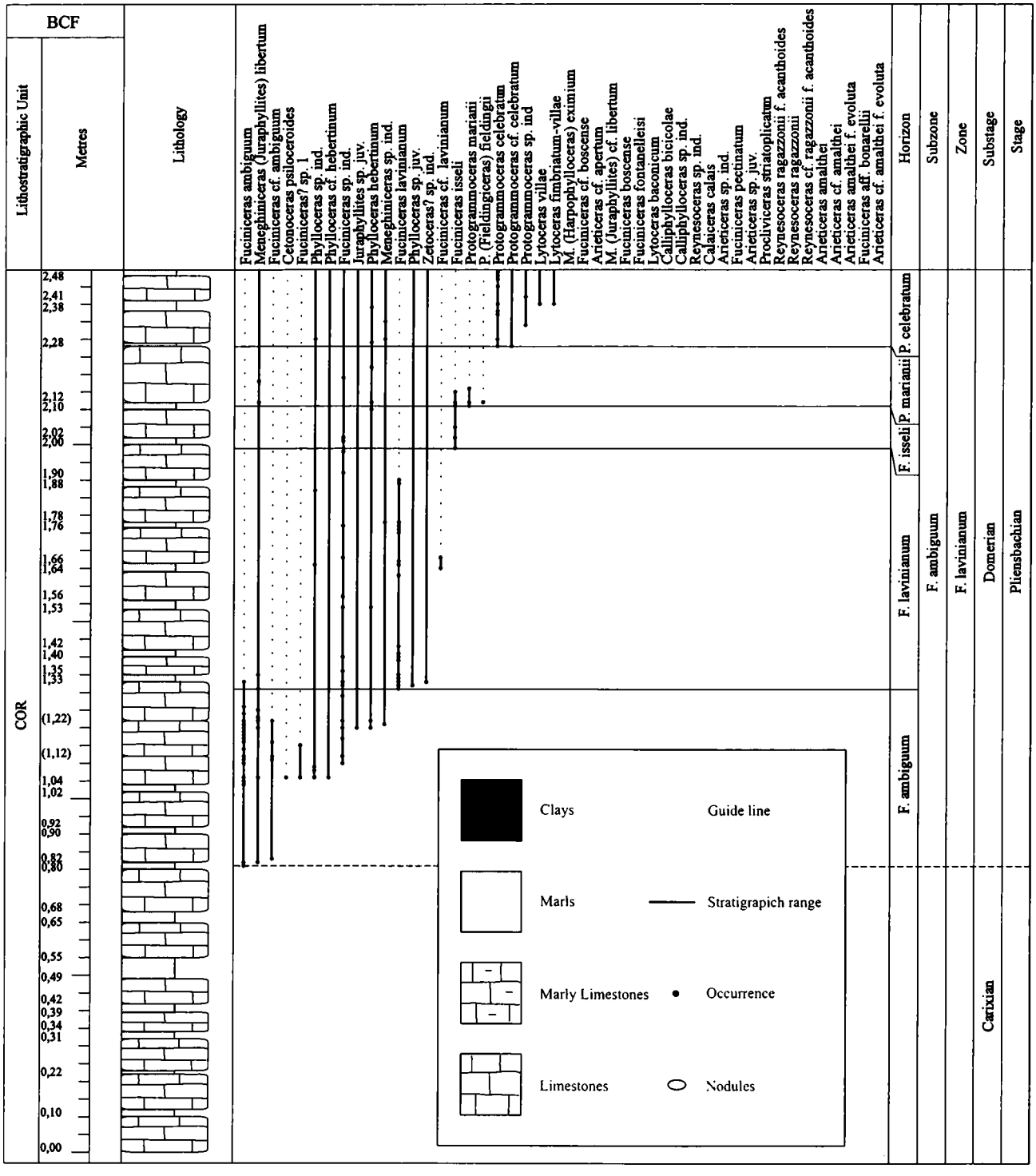
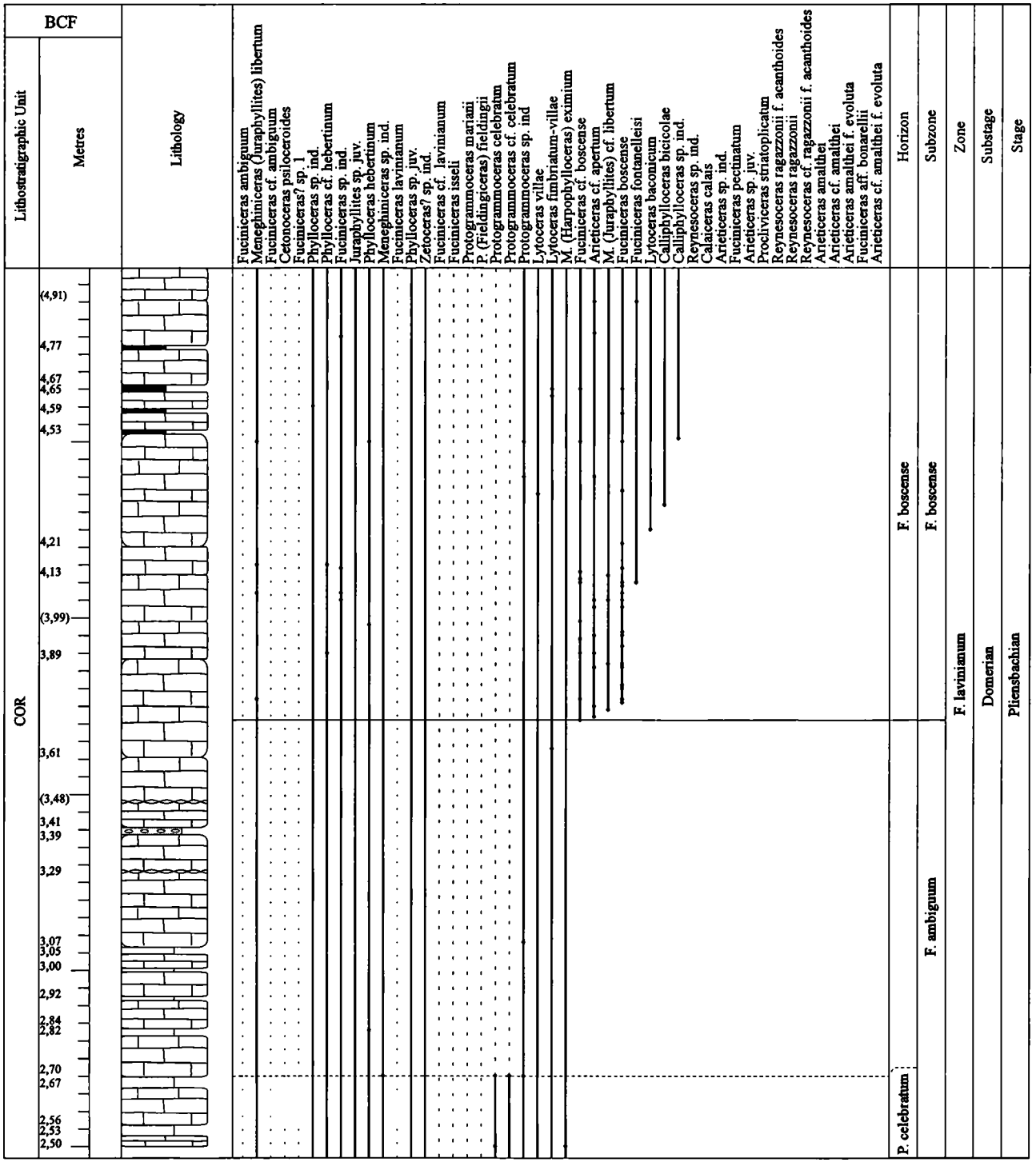


Fig. 2: Litho-biostratigraphy of the Burano Gorge Section (BCF).



In a study about ammonites morphometry, FERRETTI (1991) figured also some specimens collected in this section, from the beds comprising the base of Domerian and the middle part of the *A. algovianum* Zone. Finally, data regarding the whole Domerian of this section were presented by FERRETTI & MEISTER (1994). The aim of the work was to compare the quantitative faunal spectra of various apenninic section with some other areas of the Mediterranean and the NW- Europe but no biostratigraphical data were presented.

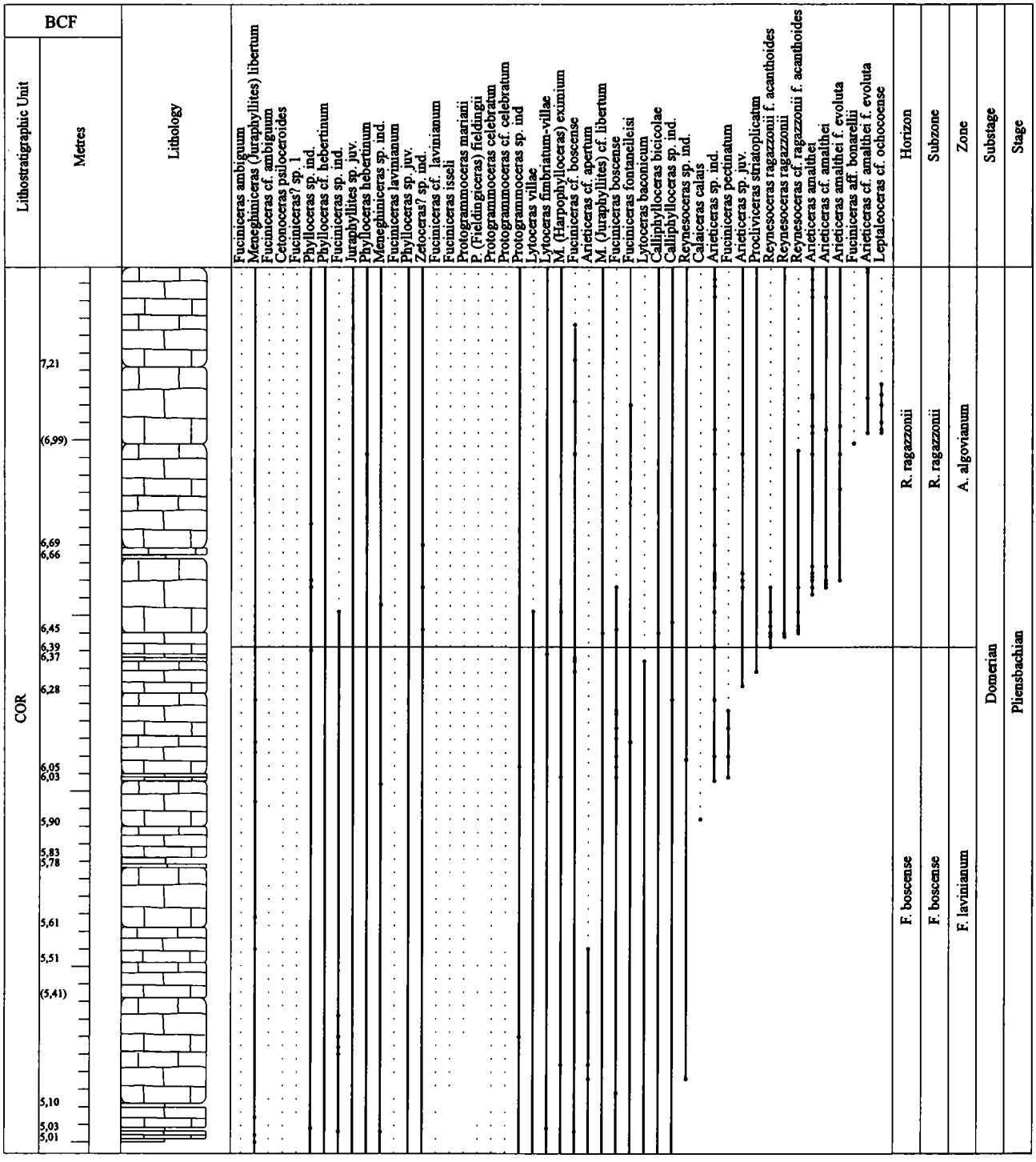
Fig. 3: Litho-biostratigraphy of the Burano Gorge Section (BCF).



SYSTEMATIC PALEONTOLOGY

The Pliensbachian fauna has received the attention of many ammonite specialists over the last 20 years. These studies were carried out both in the Mediterranean area and in NW-Europe, in particular in the Betic chain (BRAGA, 1983), in the Umbria-Marche Apennines (FERRETTI, 1991), in the Upper Austroalpine of Austria (BLAU & MEISTER, 1991; MEISTER & BÖHM, 1993; DOMMERGUES *et al.*, 1995) and Hungary (GÉCZY & MEISTER, 1998), in the Causses basin (MEISTER, 1986, 1989; DOMMERGUES &

Fig. 4: Litho-biostratigraphy of the Burano Gorge Section (BCF).

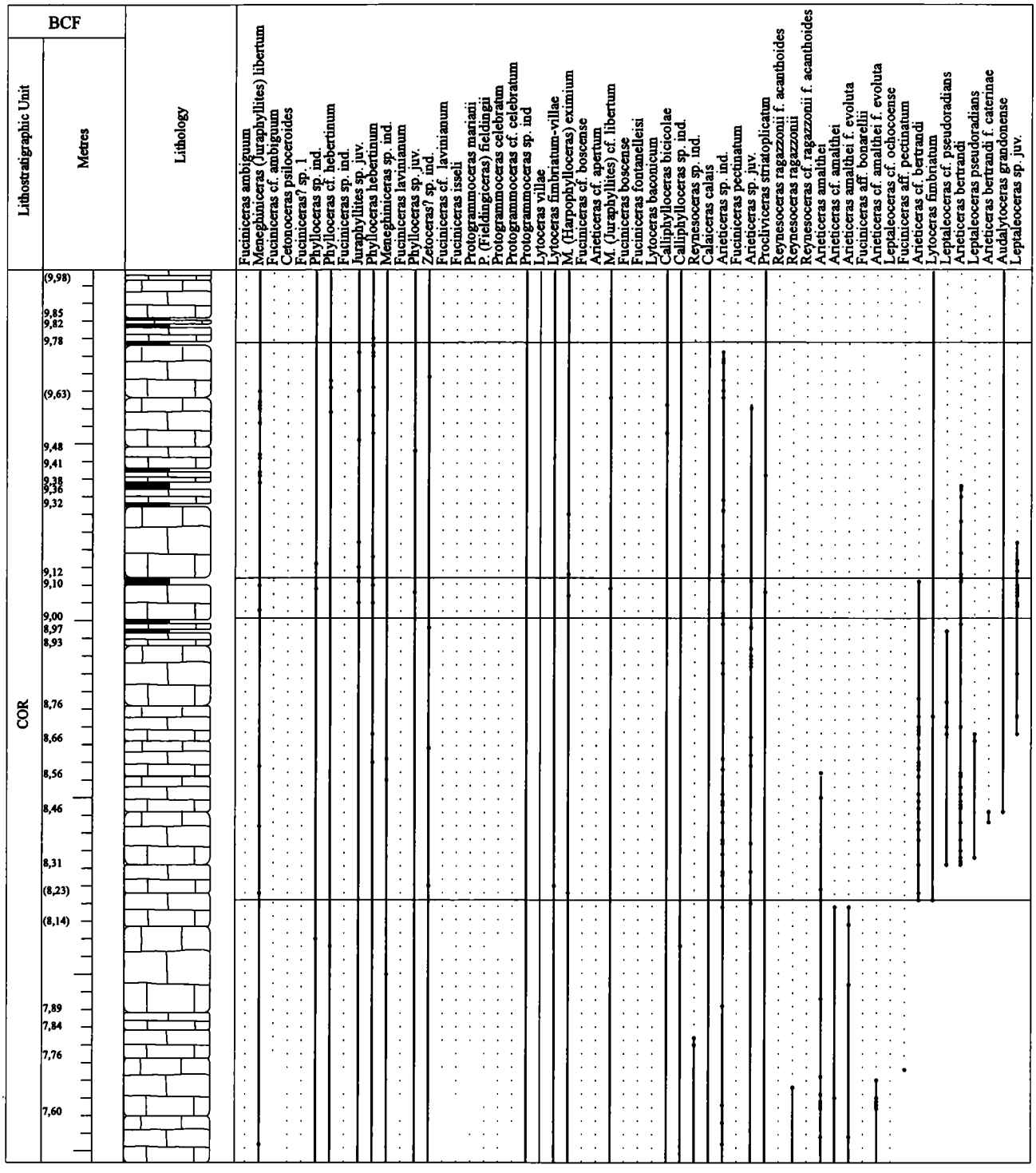


MEISTER, 1985, 1986) and in the Southern Calcareous Alps (WIEDENMAYER, 1977, 1980; DOMMERGUES *et al.*, 1997b). The accurate Stratigraphical sampling methods adopted in most of these works have led to more detailed knowledge of the degree of morphological variability of many species and allowed specification of their biostratigraphical position.

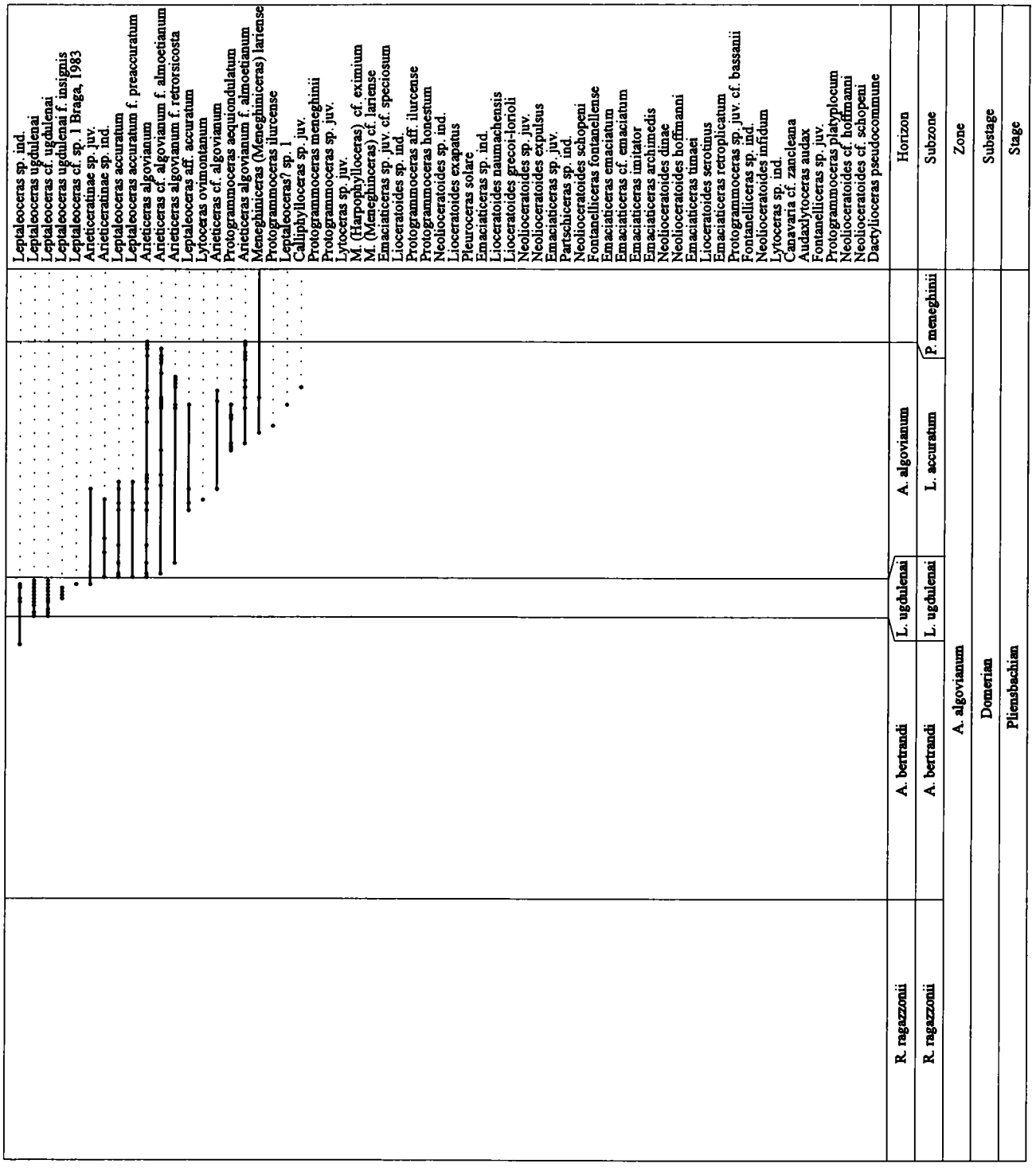
The following taxonomic discussions were developed in detail only when it was possible to complete the data obtained by the above-mentioned authors, or in cases of different interpretations of species definitions.

For Domerian taxonomy, the nomenclature of the ornamental elements of the shell is taken from ARKELL *et al.* (1957).

Fig. 5a, b: Litho-biostratigraphy of the Burano Gorge Section (BCF).



Every specimen has an inventory number composed of a progressive location number before the code of the section. The latter is followed in turn by the metres which refer to the stratigraphical position of the specimen (e.g. 307MM3.05). As previously said (see text 1) the stratigraphical distribution of the taxa treated in this paper are those resulting from the whole field work, i.e. taking into account also the data obtained form the Cerradura and the Infernaccio sections.



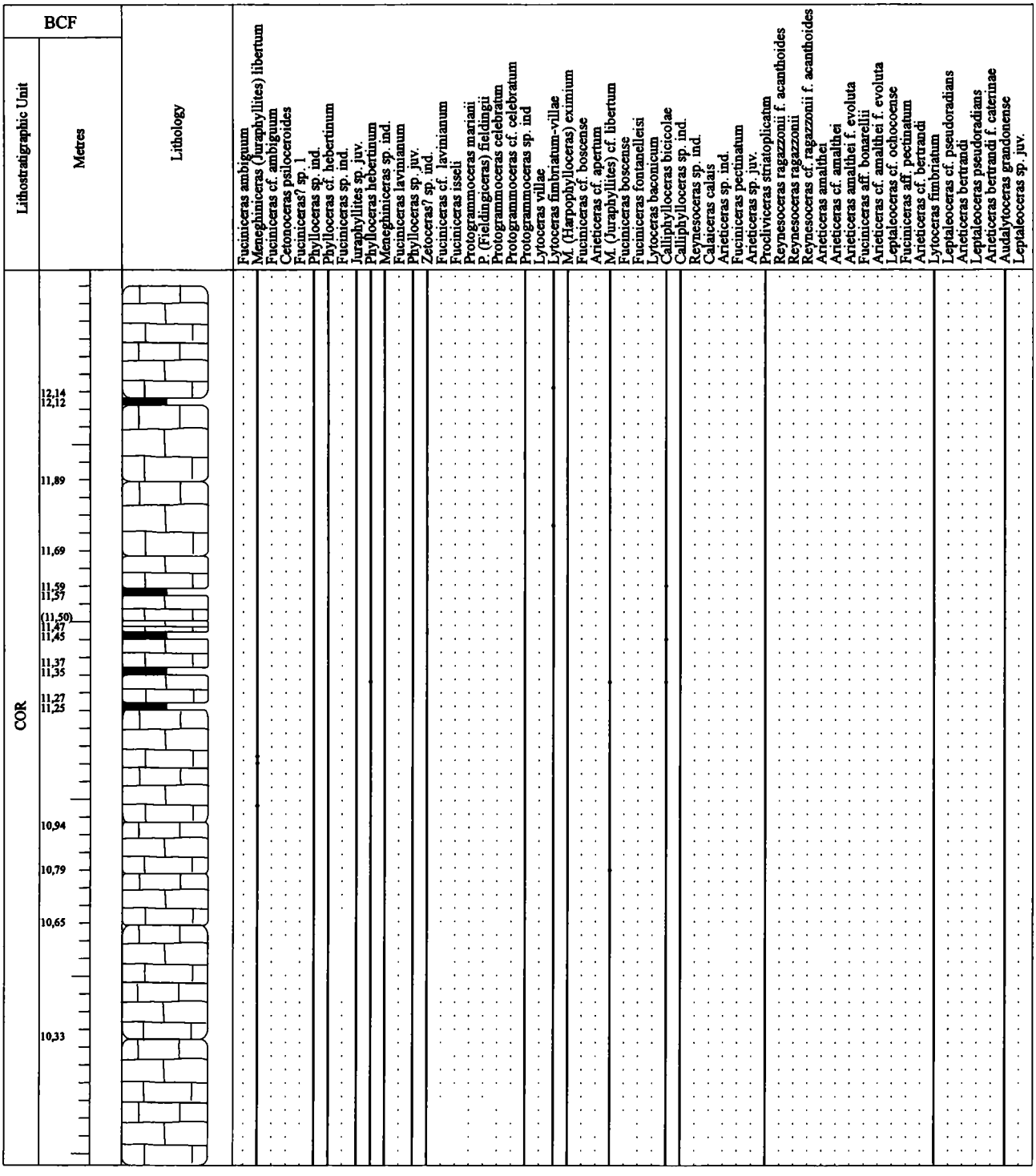
Suborder Phylloceratina ARKELL, 1950
Superfamily Phylloceratoidea ZITTEL, 1884
Family Phylloceratidae ZITTEL, 1884
Subfamily Phylloceratinae ZITTEL, 1884
Genus *Phylloceras* SUESS, 1865

Type species: *Ammonites heterophyllus* J. SOWERBY, 1820.

***Phylloceras hebertinum* (REYNES, 1868)**
Pl. I, figs 1-4

1868. *Ammonites Hebertinus* REYNES, pl. 2, fig. 3.
1868. *Ammonites frondosus* REYNES, pl. 5, fig. 1.
1884. *Phylloceras meneghinii* GEMMELLARO.- pl. 12, fig. 23.
1977. *Phylloceras meneghinii* GEMMELLARO.- WIEDENMAYER, pl. 1, figs 2, 5, 6.

Fig. 6a, b: Litho-biostratigraphy of the Burano Gorge Section (BCF).



1987. *Phylloceras frondosum* (REYNES).- BRAGA & RIVAS, pl. 1, fig. 2.

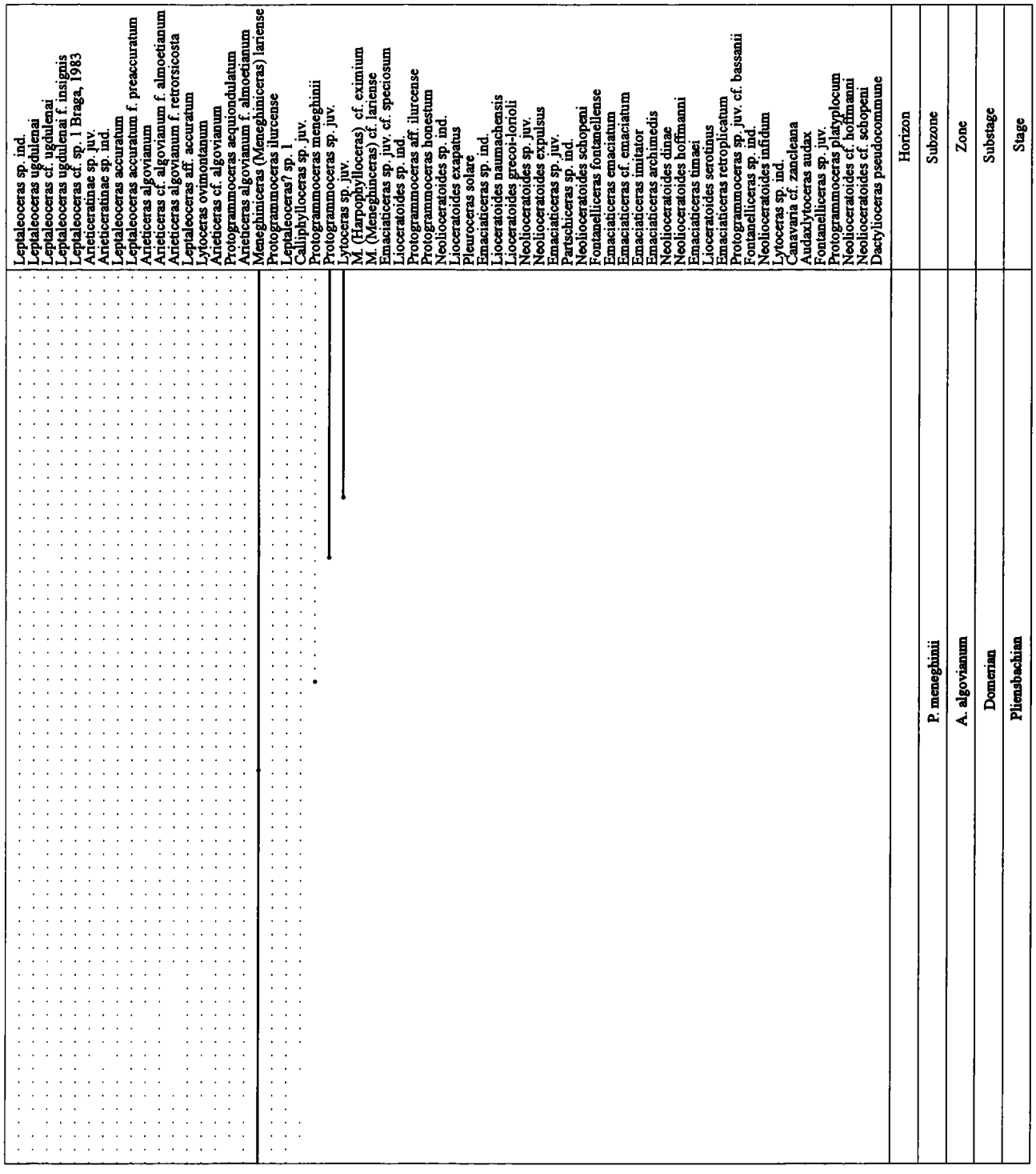
1987. *Phylloceras meneghinii* (REYNES).- BRAGA & RIVAS, pl. 1, fig. 1.

1989. *Phylloceras hebertinum* (REYNES).- MEISTER, pl. 2, figs 5, 7, with synonymy.

1989. *Phylloceras frondosum* (REYNES).- MEISTER, pl. 2, fig. 2, non 1; with synonymy.

1991. *Phylloceras* (*Phylloceras*) *hebertinum* (REYNES).- COPE, pl. 1, fig. 1.

1991. *Phylloceras* (*Phylloceras*) *frondosum* (REYNES).- COPE, pl. 1, figs 2, 6.



1993. *Phylloceras* gr. *frondosum* (REYNES).- MEISTER & BÖHM, pl. 2, figs 1, 2.

1994. *Phylloceras* gr. *hebertinum* (REYNES) - *frondosum* (REYNES).- DOMMERGUES *et al.*, pl. 1, fig. 4.

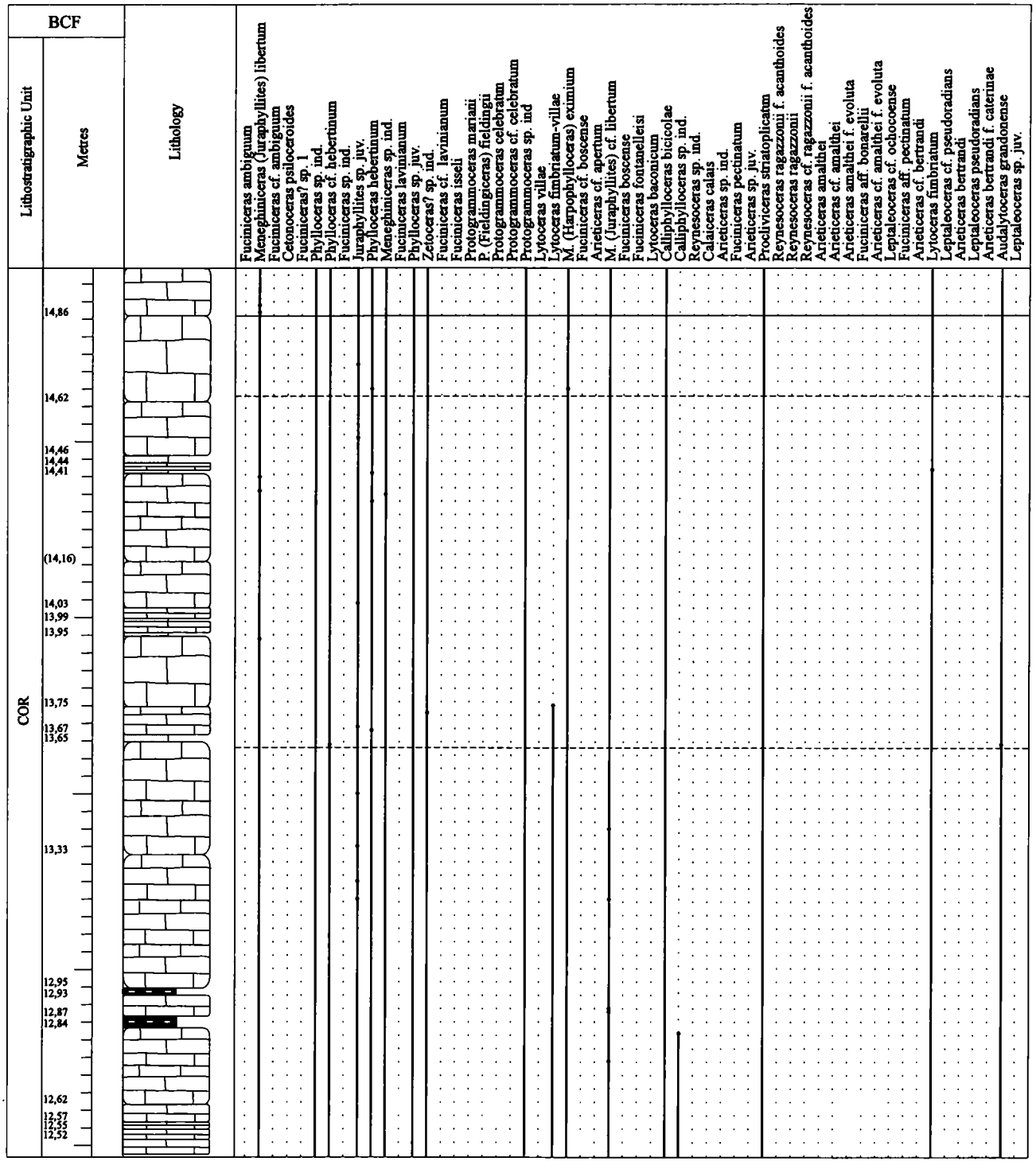
1995. *Phylloceras hebertinum* (REYNES).- ALKAYA & MEISTER, pl. 1, fig. 6.

1995. *Phylloceras frondosum* (REYNES).- ALKAYA & MEISTER, pl. 1, figs 1, 2.

1996. *Phylloceras frondosum* (REYNES).- POPA & PATRULIUS, pl. 3, fig. 2.

1998. *Phylloceras frondosum* (REYNES).- GÉCZY & MEISTER, pl. 1, figs 1-4.

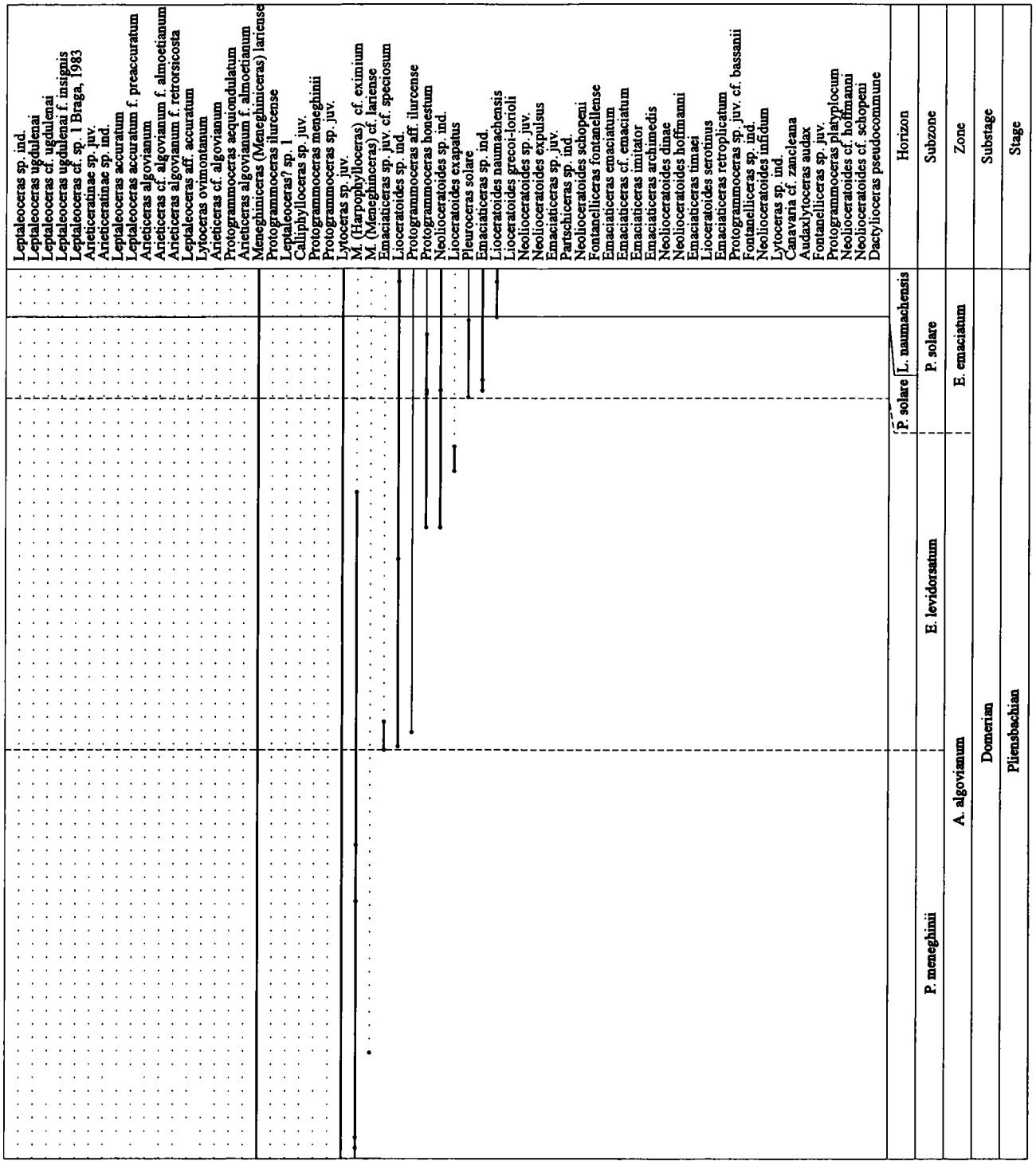
Fig. 7a, b: Litho-biostratigraphy of the Burano Gorge Section (BCF).



2001. *Phylloceras frondosum* (REYNES).- MACCHIONI, pl. 1, fig. 2.

Discussion: *P. hebertinum* (REYNES) and *P. frondosum* (REYNES) were figured in the same plate. According to GÉCZY & MEISTER (1998), they can considered two morphologic extremes of the same species. Due to the priority of figuration *P. frondosum* (REYNES) is thus considered a junior synonym of *P. hebertinum* (REYNES). No evident differences are detectable between the latter and *P. meneghinii* (GEMMELLARO) which is consequently entered in synonymy.

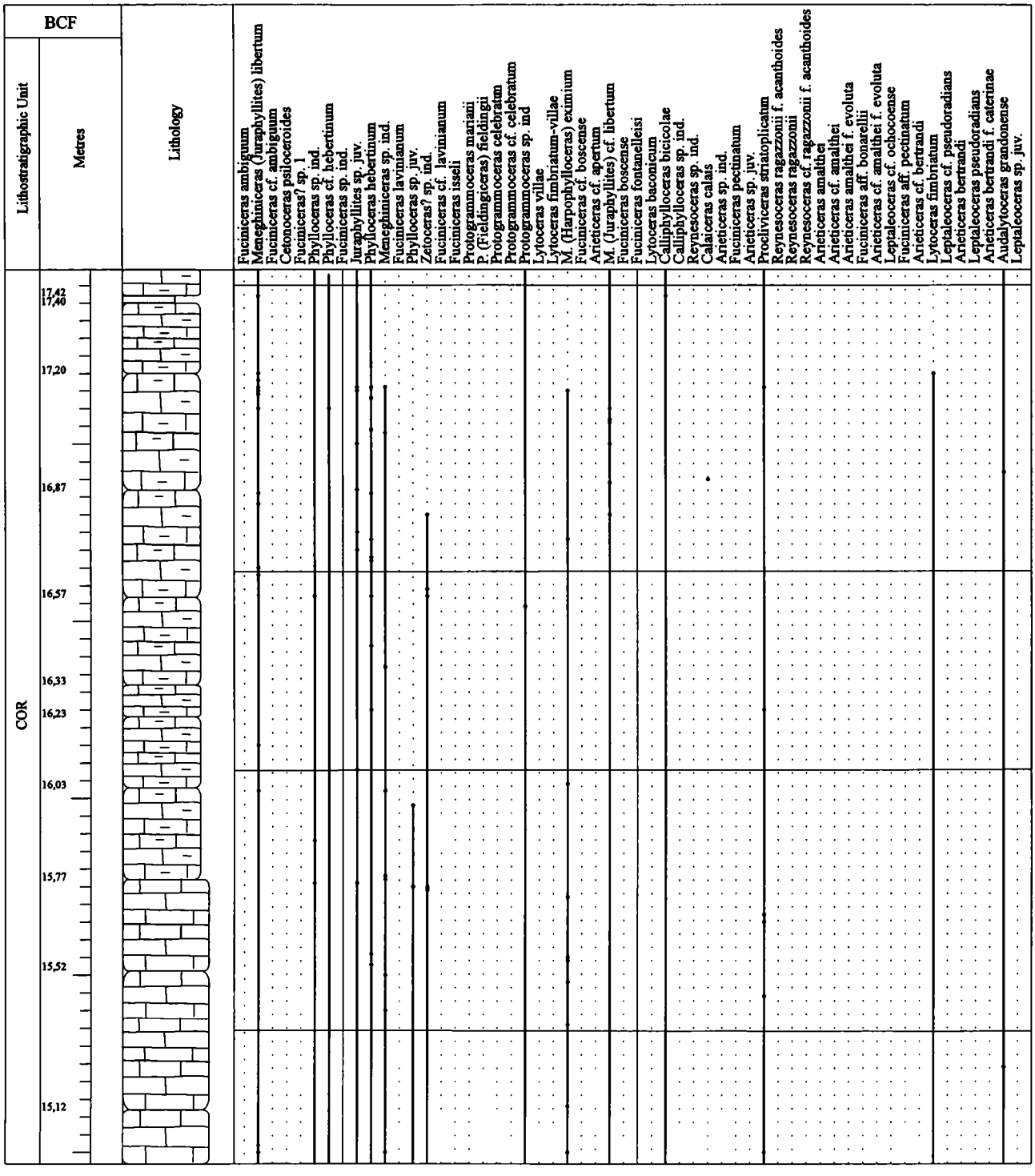
Stratigraphical distribution: The species has been

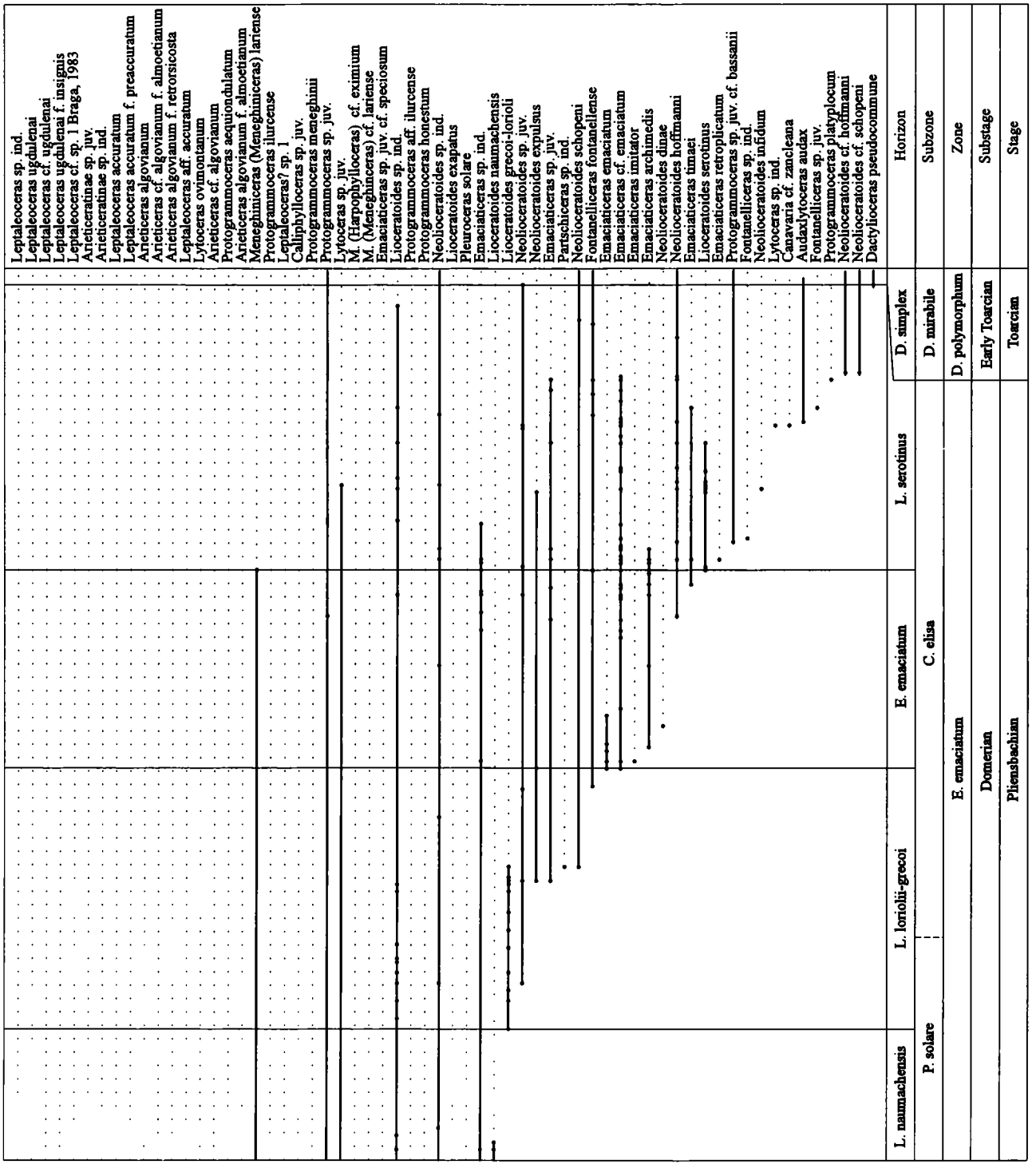


observed occurring from the lower Domerian up to the Early Toarcian. According to GÉCZY & MEISTER (1998) it can be found as far back as the upper Sinemurian.

Geographical distribution: The species has a wide Geographical distribution: it is known in almost all the Western Tethys, excepted in High Atlas (MEISTER & STAMPFLI, 2000), as far as the Pontides (ALKAYA & MEISTER, 1995). Until today the only findings reported from the Boreal Realm are those of MEISTER (1989). From the list of synonymies the species occurs in Austrian Upper Austroalpine, Bakony, Betic chain,

Fig. 8a, b: Litho-biostratigraphy of the Burano Gorge Section (BCF).




Leptaleoceras sp. ind.
Leptaleoceras ugdulenai
Leptaleoceras cf. ugdulenai
Leptaleoceras ugdulenai f. insignis
Leptaleoceras cf. sp. 1 Braga, 1983
Arieticeratinae sp. juv.
Arieticeratinae sp. ind.
Leptaleoceras accuratum
Leptaleoceras accuratum f. preaccuratum
Arieticeras algovianum
Arieticeras cf. algovianum f. almoetianum
Arieticeras algovianum f. retrorsicosta
Leptaleoceras aff. accuratum
Lytoceras ovimontanum
Arieticeras cf. algovianum
Protogrammoceras aequiondulatum
Arieticeras algovianum f. almoetianum
Meneghiniceras (Meneghiniceras) lariense
Protogrammoceras ilurcense
Leptaleoceras? sp. 1
Calliphylloceras sp. juv.
Protogrammoceras meneghinii
Protogrammoceras sp. juv.
Lytoceras sp. juv.
M. (Harpophylloceras) cf. eximium
M. (Meneghiniceras) cf. lariense
Emaciaticeras sp. juv. cf. speciosum
Lioceratoides sp. ind.
Protogrammoceras aff. ilurcense
Protogrammoceras honestum
Neolioceratoides sp. ind.
Lioceratoides exapatus
Pleuroceras solare
Emaciaticeras sp. ind.
Lioceratoides naumachensis
Lioceratoides grecoi-lorioli
Neolioceratoides sp. juv.
Neolioceratoides expulsus
Emaciaticeras sp. juv.
Partschiceras sp. ind.
Neolioceratoides schopeni
Fontanelliceras fontanellense
Emaciaticeras emaciatum
Emaciaticeras cf. emaciatum
Emaciaticeras imitator
Emaciaticeras archimedis
Neolioceratoides dinae
Neolioceratoides hoffmanni
Emaciaticeras timaei
Lioceratoides serotinus
Emaciaticeras retroplicatum
Protogrammoceras sp. juv. cf. bassanii
Fontanelliceras sp. ind.
Neolioceratoides infidum
Lytoceras sp. ind.
Canavaria cf. zancleana
Audaxlytoceras audax
Fontanelliceras sp. juv.
Protogrammoceras platyplocum
Neolioceratoides cf. hoffmanni
Neolioceratoides cf. schopeni
Dactylioceras pseudocommune
L. naumachensis
L. lorioli-grecoi
E. emaciatum
L. serotinus
D. simplex
Horizon
P. solare
C. elisa
D. mirabile
Subzone
E. emaciatum
D. polymorphum
Zone
Domerian
Early Toarcian
Substage
Pliensbachian
Toarcian
Stage

Causses, Southern Calcareous Alps, Epirus (Greece), and the Umbria-Marche Apennines.

Genus *Calliphylloceras* SPATH, 1927

Type species: *Phylloceras disputabile* ZITTEL, 1869.

Calliphylloceras bicicolae (MENEGHINI, 1874) Pl. I, figs 5, 6

1874. *Phylloceras Bicicolae* MENEGHINI, p. 106.
1867-81. *Ammonites* (*Phylloceras*) *Bicicolae* MENEGHINI, pl. 19, fig. 7.
1974. *Calliphylloceras bicicolae* (MENEGHINI).- FANTINI SESTINI, pl. 19, fig. 4; pl. 20, figs 1, 2, with synonymy.
1987. *Calliphylloceras bicicolae* (MENEGHINI).- BRAGA & RIVAS, pl. 2, figs 4, 5, with synonymy.
1989. *Calliphylloceras bicicolae* (MENEGHINI).- MEISTER, pl. 2, figs 3, 4.
1989. *Phylloceras frondosum* (REYNES).- MEISTER, pl. 2, fig. 1, non 2.
1991. *Phylloceras* (*Calliphylloceras*) *bicicolae* (MENEGHINI).- BLAU & MEISTER, pl. 1, figs 6, 7; pl. 2, fig. 1.
1993. *P. (Calliphylloceras) bicicolae* (MENEGHINI).- MEISTER & BÖHM, pl. 1, figs 2, 5.
1995. *Calliphylloceras bicicolae* (MENEGHINI).- ALKAYA & MEISTER, pl. 2, figs 3, 4, 5.
1995. *P. (Calliphylloceras) bicicolae* (MENEGHINI).- DOMMERGUES *et al.*, pl. 1, fig. 11.
1996. *Calliphylloceras bicicolae* (MENEGHINI).- POPA & PATRULIUS, pl. 10, fig. 4.
1997b. *Calliphylloceras bicicolae* (MENEGHINI).- DOMMERGUES *et al.*, pl. 1, fig. 1.
1998. *Calliphylloceras bicicolae* (MENEGHINI).- GÉCZY & MEISTER, pl. 1, fig. 10.
2001. *Calliphylloceras bicicolae* (MENEGHINI).- MACCHIONI, pl. 1, figs 3, 4.
2002. *Calliphylloceras* gr. *bicicolae* (MENEGHINI).- DOMMERGUES *et al.*, p. 307, figs 2, 3.

Description: This well-known species is characterised by involute sub-elliptical whorls and slightly biconcave, strongly prorsiradiate constrictions.
Discussion: The systematic of the species has been clarified by BRAGA & RIVAS (1987) and accepted also by GÉCZY & MEISTER (1998), amongst others, who put in synonymy many other species that were instituted in literature (see list of synonymies). Very close to *C. bicicolae* (MENEGHINI) is *C. nilssoni* (HEBERT). The latter has a more compressed whorl section and the umbilical segment of the constriction is rectiradiate and forms a strong angle with the rest of the line.
Stratigraphical distribution: The distribution resulting from the whole field work is almost the same as *P. hebertinum* (REYNES), being found from the base of Domerian up to the Early Toarcian.
Geographical distribution: The same applies to its Geographical distribution; the list of localities taken from the list of synonymy is the following: Austrian Upper Austroalpine, Bakony, Betic chain, Causses, Southern Calcareous Alps and Umbria-Marche Apennines.

Genus *Calaiceras* KOVACS, 1939

Type species: *Phylloceras calais* MENEGHINI, 1874.

Calaiceras calais (MENEGHINI, 1874) Pl. I, figs 7, 8

1867-81. *Ammonites* (*Phylloceras*) *Calais* n. sp. MENEGHINI, p. 24, figs 1, 2.
1971. *Calaiceras calais* (MENEGHINI).- FANTINI SESTINI; pl. 31, fig. 1.
1987. *Calaiceras calais* (MENEGHINI).- BRAGA & RIVAS, p. 73, fig. 4g; pl. 2, fig. 1.
1993. *P.* (*Calaiceras*) *calais* (MENEGHINI).- MEISTER & BÖHM, pl. 1, fig. 1.
? 1994b. *Calaiceras persanense* (HERBICH).- FARAONI *et al.*; pl. 1, fig. 4.
1998. *Calaiceras calais* (MENEGHINI).- GÉCZY & MEISTER; pl. 1, fig. 1.
2001. *Calaiceras calais* (MENEGHINI).- MACCHIONI, pl. 1, figs 4, 5.

Discussion: Constrictions are not visible in the outer half of the whorl side in *C. persanense* (HERBICH, 1878; pl. 20e, fig. 3), while they are clearly visible in *C. calais* (MENEGHINI). At the same time the latter has a sub-quadrate whorl section, with slightly divergent flat sides and lighter constrictions than *C. bicicolae* (MENEGHINI).
The type specimen figured by MENEGHINI (1867-81) was lost at the time of the revision by PINNA (1969).
Stratigraphical distribution: A single specimen was found in the *F. boscense* Horizon, upper part of *F. lavinianum* Zone. The species is known also in the Lower Toarcian of the Burano.
Geographical distribution: Like the other taxa already discussed, *C. calais* (MENEGHINI) is known in almost all the western Tethys with the exception of the High Atlas (GÉCZY & MEISTER, 1998).

Calaiceras sulcatum (VADASZ, 1907)

1907. *Phylloceras sulcatum* VADÁSZ, p. 403, figs 1-4.
1910. *Phylloceras sulcatum* VADÁSZ, pl. 2, figs 4-6 (same specimen as 1907).
1998. *Calliphylloceras bicicolae* (MENEGHINI) *forme*

sulcatum (VADASZ).- GÉCZY & MEISTER, pl. 1, figs 5, 7, 9, 11.

2001. *Calaiceras sulcatum* (VADÁSZ).- MACCHIONI, pl. 2, fig. 2.

Discussion: Differs from *C. bicicolae* (MENEGHINI) and *C. calais* (MENEGHINI), respectively in its subquadrate whorl section and in the presence of a ventral furrow. The suture line is completely preserved in the ventral furrows and no corrosion phenomena are observable. This allows us to exclude the possibility, suspected by GÉCZY & MEISTER (1998), that the presence of the ventral furrow is due to the taphonomic phenomenon described by FERNANDEZ LOPEZ & MELÉNDEZ (1994).

Stratigraphical distribution: A single specimen was found in the *F. ambiguum* Horizon of the *F. lavinianum* Zone in the Cerradura (a) section.

Geographical distribution: Betic Zone, Umbria-Marche Apennines.

Genus *Hantkeniceras* KOVACS, 1939

Type species: *Ammonites Hantkeni* SCHLOENBACH, 1867.

Hantkeniceras sp. 1

2001. *Hantkeniceras* sp. 1.- MACCHIONI, pl. 1, figs 6, 7.

Description: These specimens have slightly incised prorsiradiate constrictions that differ from *C. calais* (MENEGHINI) in having more compressed whorl section.

Stratigraphical distribution: The specimen comes from the middle of *R. ragazzonii* Horizon, in the *A. algovianum* Zone.

Geographical distribution: Cerradura section, Betic chain.

Genus *Zetoceras* KOVACS, 1939

Type species: *Ammonites zetes* D'ORBIGNY, 1850.

Zetoceras? sp. ind.
Pl. I, figs 11, 12

2001. *Zetoceras*? sp. ind.- MACCHIONI, pl. 1, fig. 8.

Discussion: Some specimens characterised by small umbilicus and sub-parallel flanks are grouped here in the genus *Zetoceras* with some doubts. The bad state of preservation of their suture lines and the absence of ventral striae prevents us from distinguishing true *Zetoceras* from the inner whorls of *Procliviceras*.

Stratigraphical distribution: Middle Domerian.

Genus *Procliviceras* FUCINI, 1923

Type species: *Phylloceras proclive* ROSENBERG, 1909.

Discussion: As stated by MACCHIONI (2002a), *Partschiceras* has the same morphology of *Procliviceras*, both were instituted by FUCINI (1923) in the same paper, but *Procliviceras* has page priority.

Procliviceras striatocostatum (MENEGHINI, 1853)

1851. *Ammonites Partschi* STUR, p. 26 (*nomen nudum*).
1853. *Ammonites striatocostatus* MENEGHINI, p. 28.
1868. *Ammonites Sturi* REYNES, pl. 3, fig. 1.
1913. *Phylloceras anonymum* HAAS, pl. 1, fig. 5.
1971. *Partschiceras striatocostatum* (MENEGHINI).- FANTINI SESTINI, pl. 31, figs 2, 3; pl. 32, figs 1-3; pl. 33, figs 3, 4.
1977. *Partschiceras sturi* (REYNES).- WIEDENMAYER , pl. 2, figs 6, 7; pl. 5, figs 1-4, with synonymy.
1977. *Partschiceras striatocostatum* (MENEGHINI).- WIEDENMAYER , pl. 4, figs 5-8, with synonymy.
1987. *Partschiceras striatocostatum* (MENEGHINI).- BRAGA & RIVAS, pl. 1, figs 5-8.
1989. *Partschiceras striatocostatum* (MENEGHINI).- MEISTER, pl. 2, fig. 6.
1991. *Partschiceras striatocostatum* (MENEGHINI).- BLAU & MEISTER, pl. 2, figs 2, 3.
1993. *Partschiceras striatocostatum* (MENEGHINI).- MEISTER & BÖHM, pl. 2, figs 4.
1995. *Partschiceras* gr. *striatocostatum* (MENEGHINI).- DOMMERGES *et al.*, 1, figs 9, 12.
1995. *Partschiceras striatocostatum* (MENEGHINI).- ALKAYA & MEISTER, pl. 1, fig. 4; pl. 2, figs 1, 2.
1996. *Partschiceras striatocostatum* (MENEGHINI).- FARAONI *et al.*, pl. 1, fig. 8.
1998. *Partschiceras striatocostatum* (MENEGHINI).- GÉCZY & MEISTER, pl. 4, figs 1, 2.
2001. *Partschiceras striatocostatum* (MENEGHINI).- MACCHIONI, pl. 1, fig. 11.

Discussion: Involute shells with compressed spiral sections characterised by sub-rectiradiate striae and ribs were grouped together in this species.

Stratigraphical distribution: From the very top of *F. boscense* Horizon, in the upper *F. lavinianum* Zone, up to the Lower Toarcian. The genus (*Procliviceras* = *Partschiceras*) occurs from the Early Sinemurian and perhaps already from the Hettangian (MEISTER *et al.*, 2002).

Geographical distribution: Western Tethys, Causses and Pontides and, probably, High Atlas.

Family Juraphyllitidae ARKELL, 1950
Genus *Meneghiniceras* HYATT, 1900

Type species: *Ammonites (Phylloceras) lariensis* MENEGHINI, 1875.

Discussion: There is a general agreement in considering that the taxa *Meneghiniceras*, *Harpophylloceras* SPATH and *Juraphyllites* MULLER are very closely related to each other and should be included in the same genus (FUCINI, 1923; FANTINI SESTINI, 1974; MEISTER, 1993; EL HARIRI *et al.*, 1996, GÉCZY & MEISTER, 1998; MACCHIONI, 2001). Some authors in fact, consider *Harpophylloceras* and *Meneghiniceras* as subgenera of *Juraphyllites*. Since *Meneghiniceras* has priority of date amongst them, it will be more correct to treat *Harpophylloceras* and *Juraphyllites* as subgenera of *Meneghiniceras* (MACCHIONI 2002a).

Meneghiniceras (Meneghiniceras) lariense (MENEGHINI, 1875)
Pl. I, fig. 15, 16

1875. *Ammonites (Phylloceras) lariensis* MENEGHINI, pl. 17, figs 1-3.
1974. *Meneghiniceras lariense* (MENEGHINI).- FANTINI SESTINI, pl. 19, figs 1, 2, with synonymy.
1975. *Meneghiniceras lariense* (MENEGHINI).- FISCHER & TURINSKY, p. 597, fig. 2 (4).
1976. *Meneghiniceras lariense* (MENEGHINI).- HOWARTH, p. 775, figs 1, 2.
1994. *Meneghiniceras lariense* (MENEGHINI).- FARAONI *et al.*, pl. 1, fig. 5.
1997b. *Meneghiniceras lariense* (MENEGHINI).- DOMMERGUES *et al.*, pl. 1, fig. 2.
1997b. *Meneghiniceras lariense* (MENEGHINI).- DOMMERGUES *et al.*, pl. 1, fig. 2.
2001. *Juraphyllites (Meneghiniceras) lariense* (MENEGHINI).- MACCHIONI, pl. 1, figs 15, 18.
2002a. *Meneghiniceras (Meneghiniceras) lariense* (MENEGHINI).- MACCHIONI, fig. 37a, b, with synonymy.

Discussion: The species is kept distinct from *M. (J.). libertus* (GEMMELLARO) and *M. (H.) eximius* (HAUER) due to the presence of a crenulate keel. The more heavily ornate specimens [closer to *J. libertus* (GEMMELLARO)] develop rounded tubercles in the venter, where clavi are visible in those with finer ribs [closer to *M. (H.). eximius* (HAUER)].
MENEGHINI (1867-81) classified these two morphologies in different varieties, "*A.*" *lariense* var. *dorsinodosa* (MENEGHINI) and "*A.*" *lariense* (MENEGHINI) *sensu strictu* respectively.

Stratigraphical distribution: In the present work the lowest occurrence is located in the middle part of the *A. algovianum* Horizon, in the *A. algovianum* Zone, while the topmost is in the *L. serotinus* Horizon. In literature the species is known in a range from the lower Domerian (GÉCZY & MEISTER, 1998) up to the Early Toarcian (HOWARTH, 1976; FARAONI *et al.*, 1994).
Geographical distribution: The species is strictly Mediterranean, and the only finding outside this area was reported in England by HOWARTH (1976).

Subgenus *Juraphyllites* MÜLLER, 1939

Type species: *Phylloceras diopsis* GEMMELLARO, 1884.

Meneghiniceras (Juraphyllites) libertum (GEMMELLARO, 1884)
Pl. I, figs 13, 14

1884. *Phylloceras libertum* GEMMELLARO, pl. 2, figs 1-5.
1977. *Juraphyllites libertus* (GEMMELLARO).- WIEDENMAYER, pl. 1, fig. 4; pl. 3, figs 1, 2, 5, with synonymy.
1986. *Juraphyllites libertus* (GEMMELLARO).- MEISTER, pl. 2, fig. 8.
1989. *Juraphyllites libertus* (GEMMELLARO).- MEISTER, pl. 2, fig. 9.
1990. *Juraphyllites* gr. *libertus* (GEMMELLARO).- DOMMERGUES & MEISTER, fig. 3 (15).
1991. *Juraphyllites libertus* (GEMMELLARO).- COPE, pl. 2, figs 5, 13.
1993. *Juraphyllites* gr. *libertus* (GEMMELLARO).- MEISTER & BÖHM, pl. 2, figs 5, 9; pl. 3, fig. 5.
1995. *Juraphyllites* gr. *libertus* (GEMMELLARO).- ALKAYA & MEISTER, pl. 3, figs 1, 5, 7.
1995. *Juraphyllites libertus* (GEMMELLARO).- DOMMERGUES *et al.*, pl. 1, fig. 5.
1996. *Juraphyllites libertus* (GEMMELLARO).- FARAONI *et al.*, pl. 1, fig. 7.
1998. *Juraphyllites* gr. *libertus* (GEMMELLARO).- GÉCZY & MEISTER, pl. 4, figs 3, 5, 6.
2001. *Juraphyllites libertus* (GEMMELLARO).- MACCHIONI, pl. 1, figs 9, 10.
2002a. *Meneghiniceras (Juraphyllites) libertum* (GEMMELLARO).- MACCHIONI, fig. 40a, b, with synonymy.

Discussion: The species is characterised by the presence of strongly prorsiradiate, coarse ribs, visible in the outer half of the flank of the last half whorl (approximately) of the shell. Deep sinuous constrictions are present throughout their ontogeny.
Stratigraphical distribution: The species was found from the upper Carixian up to the Lower Toarcian, but

based upon literature its first appearance is placed in the lower Carixian.

Geographical distribution: Western Tethys to the southern part of the NW-European Domain (Causses, Subbriançonnais Alps); findings are also reported also from Pontides and the Caucasus (GÉCZY & MEISTER, 1998).

Subgenus *Harpophylloceras* SPATH, 1927

Type species: *Ammonites eximius* HAUER, 1854.

Meneghiniceras (Harpophylloceras) eximium (HAUER, 1854)
Pl. I, figs 9, 10

1854. *Ammonites eximius* HAUER, pl. 2, figs 1-4.
1974. *Harpophylloceras eximium* (HAUER).- FANTINI SESTINI, p. 219 with synonymy.
1977. *Harpophylloceras eximius* (HAUER).- WIEDENMAYER, pl. 9, figs 6-13, with synonymy.
1989. *J. (Harpophylloceras) eximius* (HAUER).- MEISTER, pl. 3, figs 1-3.
1995. *J. (Harpophylloceras) eximius* (HAUER).- DOMMERGUES *et al.*, pl. 1, fig. 10.
1996. *Harpophylloceras eximius* (HAUER).- EL HARIRI *et al.*, pl. 67, figs 3, 4.
2001. *Juraphyllites (Harpophylloceras) eximius* (HAUER).- MACCHIONI, pl. 1, figs 12, 13.
2002a. *Meneghiniceras (Harpophylloceras) eximium* (HAUER).- MACCHIONI, fig. 39, with synonymy.

Discussion: Differs from *M. (Juraphyllites) libertum* (GEMMELLARO) in its finer ornamentation, and above all due to the presence of a keel. A certain degree of variability in the presence of constrictions is accepted, as not all the specimens attribute to this species display this feature, but all the other features are the same.

Stratigraphical distribution: From lower Domerian up to the Lower Toarcian; the origin of the species seems to be located in the middle Carixian (MEISTER, 1993).

Geographical distribution: The Geographical distribution is quite similar to that of *M. (Juraphyllites) libertum* with the exception of Pontides.

Suborder Lytoceratina HYATT, 1889

Remark: The phylogeny of the Early Jurassic ammonoids is still not well understood. As reassumed by DOMMERGUES (2002), the opinion of the Early Jurassic ammonite systematicians is divided in two main groups. One of them refers to the proposition of HOUSA (1965) which is not very far from the classical taxonomic scheme. According to HOUSA (*ibidem*) the origin of the lytoceratids must be seek in the Triassic ammonite fauna. This stock gave origin to the psiloceratids and eoderoceratids that were grouped together in the order Psiloceratida HOUSA (1965).

In the phylogenetic scheme proposed by GUEX (1987) instead, the earliest psiloceratids are the ancestors of lytoceratids and they all must be grouped in the order Psiloceratida *sensu* GUEX (1987).

We keep provisionally the classic taxonomic arrangement, i.e. the subdivision in the three suborders Ammonitina HYATT, Lytoceratina HYATT and Phylloceratina ARKELL pending for a better understanding of the phylogeny of the Early Jurassic ammonites.

Superfamily Lytoceratoidea NEUMAYR, 1875
Family Lytoceratidae NEUMAYR, 1875
Genus *Lytoceras* SUESS, 1865

Type species: *Ammonites fimbriatus* J. SOWERBY, 1817.

Lytoceras fimbriatum (J. SOWERBY, 1817)

1817. *Ammonites fimbriatus* J. SOWERBY, pl. 164.
1913. *Lytoceras fimbriatum* (SOWERBY).- PIA, pl. 15, fig. 7.
1986. *Lytoceras fimbriatum* (SOWERBY).- MEISTER, pl. 1, figs 1, 2, with synonymy.
1987. *Lytoceras fimbriatum* (J. SOWERBY).- BRAGA *et al.*, p. 8, figs 1a-c, 5a, b; pl. 1, figs 1, 2.
1990. *Lytoceras* gr. *fimbriatum* (SOWERBY).- DOMMERGUES *et al.*, p. 639, fig. 5(22).
1993. *Lytoceras* gr. *fimbriatum* (SOWERBY).- MEISTER & BÖHM, pl. 4, figs 1, 2.
1996. *Lytoceras fimbriatum* (SOWERBY).- EL HARIRI *et al.*, pl. 67, figs 11, 12.
1997. *Lytoceras fimbriatum* (SOWERBY).- CASSEL, pl. 16, fig. 5.
1998. *Lytoceras* gr. *fimbriatum* (SOWERBY).- GÉCZY & MEISTER, pl. 4, fig. 10.
2001. *Lytoceras fimbriatum* (J. SOWERBY).- MACCHIONI, pl. 1, fig. 16.
2002a. *Lytoceras fimbriatum* (J. SOWERBY).- MACCHIONI, fig. 41, with synonymy.

Description: Serpenticones with rounded whorl section and single, rectiradiate crenulate ribs and striae.

Stratigraphical distribution: The range observed in this study is from the base of the Domerian up to the Lower Toarcian, in *D. semicelatum* Zone. According to GÉCZY & MEISTER (1998) the first appearance of the taxon is probably located in the lower Carixian.

Geographical distribution: The species has a wide geographical distribution though it cannot be considered pandemic as it seems absent from the Pacific area.

Lytoceras villae MENEGHINI, 1874

1874. *Ammonites* (*Lytoceras*) *Villae* MENEGHINI, p. 107.
1977. *Kallilytoceras villae* (MENEGHINI).- WIEDENMAYER, pl. 10, figs 8-11.
1987. *Lytoceras villae* MENEGHINI.- BRAGA *et al.*, pl. 1, fig. 6; pl. 2, figs 1-4, with synonymy.
1989. *Lytoceras villae* MENEGHINI.- MEISTER, pl. 1, figs 1, 3, 6, 7.
1991. *Lytoceras* gr. *villae* MENEGHINI.- DOMMERGUES & MEISTER, pl. 1, figs 1, 2.
1998. *Lytoceras* gr. *villae* MENEGHINI.- GÉCZY & MEISTER, pl. 4, figs 9, 11.
2001. *Lytoceras fimbriatum* (J. SOWERBY).- MACCHIONI, pl. 1, fig. 16.
2002a. *Lytoceras fimbriatum* (J. SOWERBY).- MACCHIONI, fig. 41, with synonymy.

Discussion: According to MACCHIONI (2002a) both *L. fimbriatum* (SOWERBY) and *L. villae* (MENEGHINI) have rib bifurcations. These are more common in the latter but its peculiarity is the presence of undulate thin ribs whilst in *L. fimbriatum* (SOWERBY) ribs are only straight. Furthermore, SOWERBY's holotype possesses also some clear peristomal constrictions which are totally absent in *L. villae* (MENEGHINI), *L. ovimontanum* GEYER and *L. baconicum* VADASZ.
Stratigraphical distribution: From the lower Domerian, *F. ambiguum* Horizon, up to the Lower Toarcian. The species probably occurs from the middle Carixian (GÉCZY & MEISTER, 1998).
Geographical distribution: Western Tethys, Causses, Subbriançonnais unit.

Lytoceras baconicum VADASZ, 1910
Pl. I, figs 17, 20

1910. *Lytoceras baconicum* VADASZ, p. 75, app. 24, 25.
1977. *Kallilytoceras baconicum* (VADÁSZ).- WIEDENMAYER, pl. 11, figs 6, 7, with synonymy.
1991. *Lytoceras* gr. *baconicum* VADÁSZ.- BLAU & MEISTER, pl. 1, figs 10, 11; pl. 4, fig. 1.
1998. *Lytoceras* gr. *baconicum* VADÁSZ.- GÉCZY & MEISTER, pl. 6, fig. 1.
2001. *Lytoceras baconicum* VADÁSZ.- MACCHIONI, pl. 2, figs 1, 2.

Discussion: This species is kept distinct from *L. villae* MENEGHINI due to its larger, fairly depressed, spiral section. They share similar ribbing, although ribs are somewhat coarser in *L. baconicum* VADÁSZ.
Stratigraphical distribution: During this work the species was only found in the *F. boscense* Horizon of the *F. lavinianum* Zone, while in Hungary it has also been found at the base of the Domerian.
Geographical distribution: This is the southernmost recording of the species; until today it was only known in the northern western Tethyan margin (Southern Calcareous Alps, Upper Austroalpine of Austria and Hungary).

Lytoceras ovimontanum GEYER, 1893

1893. *Lytoceras ovimontanum* GEYER, pl. 8, fig. 1.
1977. *Kallilytoceras ovimontanum* (GEYER).- WIEDENMAYER, pl. 10, fig. 12 with synonymy.
1996. *Lytoceras ovimontanum* GEYER.- EL HARIRI *et al.*, pl. 67, fig. 15.
1998. *Lytoceras ovimontanum* GEYER.- GÉCZY & MEISTER, pl. 5, figs 1, 6, 7.
2001. *Lytoceras ovimontanum* GEYER.- MACCHIONI, pl. 2, figs 3-5.

Discussion: These forms differ from *L. villae* MENEGHINI and *L. baconicum* VADÁSZ in having a suboval whorl section.
Stratigraphical distribution: Upper *F. boscense* Horizon in the *F. lavinianum* Zone, up to the *R. ragazzonii* Horizon in the lower part of the *A. algovianum* Zone. In literature, the species is known ranging trough almost the whole Domerian (GÉCZY & MEISTER, 1998).
Geographical distribution: Western Tethys.

Genus *Audaxlytoceras* FUCINI, 1923

Type species: *Lytoceras audax* MENEGHINI, 1881.

Audaxlytoceras audax (MENEGHINI, 1881)

1881. *Lytoceras audax* MENEGHINI, pl. 5, fig. 6.
? 1893. *Lytoceras* sp. GEYER, pl. 8, figs 10a, b.
1899. *Lytoceras audax* MENEGHINI.- FUCINI, pl. 20, fig. 6.
1913. *Lytoceras audax* MENEGHINI.- HAAS, pl. 1, fig. 23.
1927. *Lytoceras* aff. *audax* MENEGHINI.- SCHRÖDER, pl. 9, fig. 1.
1934. *Lytoceras audax* MENEGHINI.- MONESTIER, pl. 4, figs 49, 50.
1962. *Audaxlytoceras audax* (MENEGHINI).- FANTINI SESTINI, pl. 38, figs 9-10.
? 1966. *Audaxlytoceras audax* (MENEGHINI).- KOLLAROVA-ANDRUSOVA, pl. 2, figs 6, 7, 8.
1973. *Audaxlytoceras audax* (MENEGHINI).- FANTINI SESTINI, pl. 49, figs 1-3, with sysnonymy.
1991. *Audaxlytoceras audax* (MENEGHINI).- COPE, pl. 1, fig. 9.
1995. *Audaxlytoceras audax* (MENEGHINI).- ALKAYA & MEISTER, pl. 4, fig. 3.

1998. *Audaxlytoceras* gr. *audax* (MENEGHINI).- GÉCZY & MEISTER, pl. 5, figs 3, 5.
2001. *Audaxlytoceras audax* (MENEGHINI).- MACCHIONI, pl. 2, figs 6, 7.

Discussion: Evolute, smooth, small specimens, with a subelliptical compressed whorl section and laterally convex constrictions.
Stratigraphical distribution: The species has been found in almost the whole of the Domerian.
Geographical distribution: Western Tethys.

Audaxlytoceras grandonense (MENEGHINI, 1881) Pl. II, fig. 1

1881. *Ammonites* (*Lytoceras*) *grandonensis* MENEGHINI, pl. 5, fig. 7.
1962. *Audaxlytoceras? grandonensis* (MENEGHINI).- FANTINI SESTINI, pl. 38, figs 12, 13.
1968. *AegoLytoceras grandonense* (MENEGHINI).- CANTALUPPI & SAVI, pl. 19, fig. 4.
1968. *AegoLytoceras grandonense* (MENEGHINI).- CANTALUPPI & MONTANARI, pl. 12, fig. 8.
1973. *Audaxlytoceras grandonense* (MENEGHINI).- FANTINI SESTINI, p. 492.
1987. *Audaxlytoceras grandonense* (MENEGHINI).- BRAGA *et al.*, pl. 2, figs 8, 9.
1998. *Audaxlytoceras grandonense* (MENEGHINI).- GÉCZY & MEISTER, pl. 5, figs 4; 6, fig. 2.
2001. *Audaxlytoceras grandonense* (MENEGHINI).- MACCHIONI, pl. 1, fig. 19.

Discussion: Differs from *A. audax* (MENEGHINI) in having a subquadrate whorl section, but it is almost identical in other all shell features. Due to the presence of striae, MACCHIONI (2002a) kept distinct *A. fuggeri* (GEYER) from *A. grandonense* and *A. audax* where the presence of this character has never been reported so far. As mentioned by the author, the striae might also indicate a sing of maturity rather than a true diagnostic element of separation.
Stratigraphical distribution: From the upper part of the *F. boscense* Horizon in the *F. lavinianum* Zone up to the Lower Domerian. According to GÉCZY & MEISTER (1998), in Hungary the species occurs already since the *F. isseli* Horizon of the *F. lavinianum* Zone.
Geographical distribution: Western Tethys.

Genus *Derolytoceras* ROSENBERG, 1909

Type species: *Ammonites lineatus tortus* QUENSTEDT, 1885.

Derolytoceras tortum (QUENSTEDT, 1885)

1885. *Ammonites lineatus tortus* QUENSTEDT, pl. 39, fig. 12, 13.
1989. *Derolytoceras tortum* (QUENSTEDT).- MEISTER & LOUP, pl. 6, fig. 7.
1990. *Derolytoceras tortum* (QUENSTEDT).- DOMMERGUES *et al.*, pl. 6, figs 8, 9, with synonymy.
1990. *Derolytoceras tortum* (QUENSTEDT).- DOMMERGUES & MEISTER, figs 3 (13, 14); fig. 5 (23).
1991. *Derolytoceras tortum* (QUENSTEDT).- BLAU & MEISTER, p. 178.
2001. *Derolytoceras tortum* (QUENSTEDT).- MACCHIONI, pl. 2, fig. 8.

Discussion: Two small fragments of body chamber collected in the Cerradura (CEb) section are referred to this species because of the presence of coarse acute annular ribs located at the end of the shell. Some authors (e.g. MEISTER, 1986) interpret this species as the microconch of the contemporary *Lytoceras* species.
Stratigraphical distribution: The specimens were collected in *R. ragazzonii* Horizon, at the base of *A. algovianum* Zone.
Geographical distribution: There are more findings of this species in NW-Europe than those reported from the Tethyan area.

Suborder Ammonitina HYATT, 1889
Superfamily Eoderoceratoidea SPATH, 1929
Family Phricodoceratidae SPATH, 1938
Genus *Phricodoceras* HYATT, 1900

Type species: *Ammonites taylori* SOWERBY, 1826.

Phricodoceras cf. *imbricatum* (BETTONI, 1900)

1900. *Aegoceras imbricatum* BETTONI, pl. 8, figs 20, 21.
1908. *Phricodoceras imbricatum* (BETTONI).- FUCINI, pl. 1, figs 17, 19.
1978. *Phricodoceras imbricatum* (BETTONI).- FANTINI SESTINI, pl. 28, figs 2, 5.
1980. *Phricodoceras imbricatum* (BETTONI).- WIEDENMAYER, pl. 2, figs 4-8.
2001. *Phricodoceras imbricatum* (BETTONI).- MACCHIONI, pl. 2, fig. 10.

Discussion: This *Phricodoceras* is characterised by its unusual lamella-shaped ribs in the latter half of the last preserved whorl. Ribs are prorsiradiate and continue in the venter where they are folded forwards.
Stratigraphical distribution: The specimen was found in the lower part of *R. ragazzonii* Horizon, base of the *A. algovianum* Zone.
Geographical distribution: Southern Calcareous Alps and Betic chain.

Family Liparoceratidae HYATT, 1867 *sensu* DOMMERGUES & MEISTER, 1999
Subfamily Amaltheinae HYATT, 1867 *sensu* DOMMERGUES & MEISTER, 1999
Genus *Pleuroceras* HYATT, 1867

Type species: *Ammonites spinatus* BRUGUIÈRE, 1789.

***Pleuroceras solare* (PHILLIPS, 1829)**
Pl. II, figs 2, 3, 4, 7

1829. *Ammonites solaris* PHILLIPS pl. 4, fig. 29.
1958. *Pleuroceras solare* (PHILLIPS).- HOWARTH, pl. 4, figs 1-7, with synonymy.
1960. *Pleuroceras solare* (PHILLIPS).- JORDAN, pl. 4, figs 6-7.
1961. *Pleuroceras solare* (PHILLIPS).- TINTANT *et al.*, pl. 1, fig. 5.
1969. *Pleuroceras solare* (PHILLIPS).- POPA, pl. 1, figs 1-4.
1976. *Pleuroceras solare* (PHILLIPS).- SCHLEGEL-MILCH, pl. 36, figs 2.
1980. *Pleuroceras solare* (PHILLIPS).- WIEDEN-MAYER, pl. 3, figs 8-13.
1980. *Pleuroceras solare* (PHILLIPS) var. *trapezoidiforme* (MAUBEUGE).- WIEDENMAYER, pl. 3, figs 22, 23.
1980. *Pleuroceras solare* (PHILLIPS) var. *lene* (MAUBEUGE).- WIEDENMAYER, fl. 3, figs 14-19.
1982. *Pleuroceras solare* (PHILLIPS).- BRAGA *et al.*, pl. 3, fig. 8.
1983. *Pleuroceras solare* (PHILLIPS).- BRAGA, pl. 15, figs 14-16.
1984. *Pleuroceras solare* (PHILLIPS).- CUBAYNES *et al.*, pl. 3, fig. 20.
1985. *Pleuroceras solare* (PHILLIPS).- COMAS RENGIFO, Pl. 10, figs 5-9; pl. 11, fig. 4.
1988. *Pleuroceras solare* (PHILLIPS).- MEISTER, pl. 6, figs 6, 7, 9-11; pl. 7, figs 1-3.
1991. *Pleuroceras* aff. *solare* (PHILLIPS).- BLAU & MEISTER, pl. 5, figs 6-8.
2001. *Pleuroceras solare* (PHILLIPS).- MACCHIONI, pl. 2, figs 11, 12.

Discussion: This species, well-known in NW-Europe, occurs in the Mediterranean Province only during a brief faunal spread in the upper Domerian (BRAGA, 1983; MEISTER, 1987; GECZY & MEISTER, 1994; MEISTER & STAMPFLI, 2000; MACCHIONI & CECCA, 2002). The variability of the species was thoroughly analysed by HOWARTH (1958) and MEISTER (1988). The diagnostic characters for these amaltheids are the relatively evolute shell, with sub-rectangular Whorl section in which the fine ribs are slightly flexuous, regular and acute. Some specimens show very small tubercles localised at the ventro-lateral edge.

Stratigraphical distribution: *P. solare* Horizon at the base of *E. emaciatum* Zone.
Geographical distribution: Boreal Domain, Betic Zone, Southern Calcareous Alps, Umbria-Marche Apennines.

Family Dubariceratidae DOMMERGUES & MEISTER, 1999
Subfamily Reynesocoeloceratinae DOMMERGUES, 1986
Genus *Prodactylioceras* SPATH, 1923

Type species: *Ammonites Davoei* J. SOWERBY, 1822.

***Prodactylioceras* cf. *italicum* (FUCINI, 1900)**

1900. *Coeloceras italicum* FUCINI, pl. 13, fig. 4.
1976. *Prodactylioceras* (*Aveyroniceras*) italicum (FUCINI).- GÉCZY, pl. 25, figs 8, 9; pl. 26, figs 1-4, with synonymy.
1983. *Reynesoceras italicum* (FUCINI).- BRAGA, pl. 16, fig. 3, with synonymy.
1983. *Prodactylioceras italicum* (FUCINI).- DOMMERGUES *et al.*, pl. 6, figs 7-12.
1985. *Aveyroniceras* cf. *italicum* (FUCINI).- COMAS RENGIFO, pl. 12, fig. 2.
1993. *Prodactylioceras italicum* (FUCINI).- MEISTER & BÖHM, pl. 7, fig. 4.
1996. *Reynesoceras italicum* (FUCINI).- SMITH & TIPPER, pl. 18, fig. 3.
1998. *Prodactylioceras italicum* (FUCINI).- GÉCZY & MEISTER, pl. 6, figs 9, 12.
2001. *Prodactylioceras* cf. *italicum* (FUCINI).- MACCHIONI, pl. 2, fig. 13.

Discussion: A single small specimen characterised by cadicone whorls and very fine ribs.
Stratigraphical distribution: The exemplar was collected in the *F. ambiguum* Horizon of the *F. lavinianum* Zone. The species has a wider biostratigraphical range, occurring from the upper Carixian and probably extending to the middle part of *F. lavinianum* Zone (see GÉCZY & MEISTER, 1998).
Geographical distribution: Western Tethys and perhaps Japan and North America.

Family Dactylioceratidae HYATT, 1867 *sensu* DOMMERGUES, 1986
Genus *Reynesoceras* SPATH, 1936

Type species: *Ammonites ragazzonii* HAUER, 1861.

***Reynesoceras ragazzonii* (HAUER, 1861)**
Pl. II, figs 5, 6

1861. *Ammonites ragazzonii* HAUER, pl. 1, figs 16, 17.

1868. *Ammonites acanthoides* REYNES, pl. 1, fig. 3.
1989. *Reynesoceras ragazzonii* (HAUER).- MEISTER, pl. 5, figs 2, 6, 7, with synonymy.
1989. *Reynesoceras acanthoides* (REYNES).- MEISTER, pl. 5, figs 1, 3-5, 8-10, with synonymy.
1993. *Reynesoceras* gr. *ragazzonii* (HAUER).- MEISTER & BÖHM, pl. 7, figs 9, 11.
1996. *Reynesoceras ragazzonii* (HAUER).- SMITH & TIPPER, pl. 18, figs 6, 7.
1996. *Reynesoceras ragazzonii* (HAUER).- EL HARIRI *et al.*, pl. 70, figs 1-4.
1997a. *Reynesoceras ragazzonii* (HAUER).- DOMMERGUES *et al.*, pl. 8, fig. 10.
1997b. *Reynesoceras acanthoides* (REYNES).- DOMMERGUES *et al.*, pl. 8, fig. 8.
1997b. *Reynesoceras ragazzonii* (HAUER).- DOMMERGUES *et al.*, pl. 1, fig. 10.
2001. *Reynesoceras ragazzonii* (HAUER).- MACCHIONI, pl. 3, figs 1, 2, 4-6.

Discussion: We follow the taxonomic interpretations of FANTINI SESTINI (1975) and MEISTER (1989) who consider the small-sized adult specimens [*R. ragazzonii* (HAUER)] to be the microconch of *R. ragazzonii* f. *acanthoides* (REYNES) (see Pl. II, fig. 8, 9, 12, 16).
Stratigraphical distribution: *R. ragazzonii* Horizon, base of *A. algovianum* Zone.
Geographical distribution: Western Tethys, Causses and North America.

Superfamily Hildoceratoidea HYATT, 1867
Family Hildoceratidae HYATT, 1867
Subfamily Harpoceratinae NEUMAYR, 1875
Genus *Protogrammoceras* SPATH, 1913

Type species: *Grammoceras bassanii* FUCINI 1900 pl. 10, figs 6, 7.

Discussion: The systematics of the genus and the problems of nomenclature have already been dealt with at length by CANTALUPPI (1972), BRAGA (1983), HOWARTH (1992), NEIGE & DOMMERGUES (1995), FERRETTI (2002) and DOMMERGUES *et al.* (2002). Reference may be made to these authors for more complete lists of synonymy and a detailed discussion. The concept of the genus is that expressed by SPATH (1919), i.e. falciradiate or sub-falciradiate ribbed forms with more or less narrow ogival ventral part. In that way, it is taken herein as a quite classical and wide sense.
Stratigraphical distribution: From lower Carixian (MEISTER & STAMPFLI, 2000) to the *D. polymorphum* Zone in the Early Toarcian.

Protogrammoceras marianii (FUCINI, 1904)
Pl. II, figs 13, 14, 17

1904. *Harpoceras marianii* FUCINI, pl. 41, figs 1-3.
1972. *Protogrammoceras marianii* (FUCINI).- FERRETTI, pl. 13, fig. 6.
1977. *Protogrammoceras marianii* (FUCINI).- WIEDENMAYER, pl. 19, figs 7, 8, with synonymy.
1980. *Protogrammoceras marianii* (FUCINI).- WIEDENMAYER, pl. 12, fig. 1-3.
1989. *P.* (*Protogrammoceras*) aff. gr. *marianii* (FUCINI).- MEISTER, pl. 3, fig. 11.
1991. *Protogrammoceras* aff. gr. *mariani* (FUCINI).- BLAU & MEISTER, pl. 5, figs 26, 27.
1991. *Protogrammoceras mariani* (FUCINI).- FERRETTI, pl. 10, fig. 6, 7; pl. 11, figs 1-3.
1993. *Protogrammoceras mariani* (FUCINI).- MEISTER & BÖHM, pl. 8, figs 13, 15-17; pl. 9, fig. 2-4.
1996. *Protogrammoceras mariani* (FUCINI).- EL HARIRI *et al.*, pl. 71, figs 2, 3.
1997b. *Protogrammoceras* aff. *marianii* (FUCINI).- DOMMERGUES *et al.*, pl. 2, fig. 10.
1998. "*Protogrammoceras*" gr. *marianii* (FUCINI).- GÉCZY & MEISTER, pl. 11, figs 4-9; pl. 12, figs 1-6.
2001. *Protogrammoceras marianii* (FUCINI).- MACCHIONI, pl. 3, figs 9, 10.
?2002a. *Protogrammoceras marianii* (FUCINI).- MACCHIONI, fig. 63.
?2002a. *Fuciniceras* cf. *boscense* (REYNES).- MACCHIONI, fig. 74 a.

Description: Moderately evolute forms, with a sub-ogival whorl section and the keel still bordered by two small flat areas somewhat depressed. Ribs are falcoid, varying from rectiradiate to prorsiradiate, and a fair degree of variability was observed in their thickness and density.
Discussion: There is a great affinity in rib shape between *P. marianii* (FUCINI) and *P. bonarellii* (FUCINI), but they have different venters. In the latter, the venter is flatter and wider and the whorl section is sub-rectangular with only slight convex sides.
The specimen figured by MACCHIONI (2002a, fig. 74b), has true falcate ribs and should be better compared with *P. marianii* (FUCINI).
Stratigraphical distribution: Lower half of the *P. marianii* Horizon, in the *F. lavinianum* Zone.
Geographical distribution: Western Tethys and probably Causses basin.

Protogrammoceras aff. *bonarellii* (FUCINI, 1900)
Pl. II, figs 10, 11

v. 1900. *Grammoceras Bonarellii* FUCINI, pl. 10, figs 4, 5.
1905. *Hildoceras Bonarellii* (FUCINI).- FUCINI, pl. 15, figs 4, 5.

? 1923. *Protogrammoceras Bonarellii* (FUCINI).- FUCINI, pl. 14, figs 1, 2.
? 1927. *Hildoceras Bonarellii* (FUCINI).- SCHRÖDER, pl. 10, fig. 3.
non 1929. *Seguenziceras bonarellii* (FUCINI).- LANQUINE, pl. 5, fig. 1.
non 1934. *Fuciniceras bonarellii* (FUCINI).- MONESTIER, pl. 2, figs 12, 14-17.
? 1962. *Protogrammoceras* cf. *bonarellii* (FUCINI).- FANTINI SESTINI, pl. 40, fig. 15.
1967. *Protogrammoceras* ? aff. *bonarellii* (FUCINI).- CANTALUPPI, pl. 5, fig. 5.
1977. *Protogrammoceras* cf. *bonarellii* (FUCINI).- WIEDENMAYER, pl. 19, fig. 15.
1980. *Protogrammoceras bonarellii* (FUCINI).- WIEDENMAYER, pl. 28, fig. 16.
? 1983. *Protogrammoceras bonarellii* (FUCINI).- BRAGA, pl. 5, figs 1, 2.
2001. *Protogrammoceras* aff. *bonarellii* (FUCINI).- MACCHIONI, pl. 3, fig. 8.

Discussion: The two specimens are characterised by a venter that is narrower than that of *P. bonarellii* (FUCINI) but too wide to be included in *P. marianii* (FUCINI). Rib strength is very similar to that of *P. bonarellii* (FUCINI).
Stratigraphical distribution: *P. marianii* Horizon.
Geographical distribution: Burano Gorge and Infernaccio sections.

Protogrammoceras celebratum (FUCINI, 1900)
Pl. II, figs 18, 19, 21, 22

v.1900. *Grammoceras celebratum* FUCINI, pl. 10, fig. 1, 2.
v.1900. *Grammoceras celebratum* var. *italica* FUCINI, pl. 10, fig. 3.
1983. *Protogrammoceras celebratum* (FUCINI).- BRAGA, pl. 4, figs 2-6.
1989. *P.* (*Protogrammoceras*) *celebratum* (FUCINI).- MEISTER, pl. 3, figs 14, 15; pl. 4, fig. 1 with synonymy.
1991. *Fuciniceras celebratum* (FUCINI).- FERRETTI, pl. 11, figs 4-6.
1991. *Protogrammoceras* aff. gr. *celebratum* (FUCINI).- BLAU & MEISTER, pl. 5, figs 24-25.
1996. *Protogrammoceras celebratum* (FUCINI).- EL HARIRI *et al.* pl. 71, figs 4, 5.
1997a. *Protogrammoceras celebratum* (FUCINI).- DOMMERGUES *et al.*, pl. 8, fig. 3.
1997b. *Protogrammoceras celebratum* (FUCINI).- DOMMERGUES *et al.*; pl. 2, figs 16, 21.
1998. *Protogrammoceras* gr. *celebratum* (FUCINI).- GÉCZY & MEISTER, pl. 12, figs 7-9; pl. 13, figs 1-3, 5.
2001. *Protogrammoceras celebratum* (FUCINI).- MACCHIONI, pl. 3, figs 11, 13, 14.

Discussion: Differs from *P. marianii* (FUCINI) in having a true ogival whorl section, and denser and prorsiradiate falcate ribs.
Stratigraphical distribution: Lower half of *P. celebratum* Horizon in the *F. lavinianum* Zone.
Geographical distribution: Western Tethys, France (Burgundy, Causses) and Portugal.

Protogrammoceras aequiondulatum (BETTONI, 1900)
Pl. II, fig. 15, 19, 20, 23; Pl. III, figs 1, 2, 4, 7

1900. *Harpoceras* (?) *aequiondulatum* BETTONI, pl. 6, fig. 11.
1983. *Protogrammoceras aequiondulatum* (BETTONI).- BRAGA, pl. 5, figs 3-5 with synonymy.
1993. *Protogrammoceras* (*Paltarpites*) aff. *aequiondulatum* (BETTONI).- MEISTER & BÖHM, pl. 9, fig. 11.
1996. *Protogrammoceras* (*Protogrammoceras*) *aequiondulatum* (BETTONI).- SMITH & TIPPER, pl. 24, figs 7-9.
1996. *Protogrammoceras* (*Paltarpites*) aff. *aequiondulatum* (BETTONI).- EL HARIRI *et al.*, pl. 5, figs 6, 7.
1998. *Protogrammoceras* (*Paltarpites*) *aequiondulatum* (BETTONI).- GÉCZY & MEISTER, pl. 13, fig. 7.
2001. *Protogrammoceras aequiondulatum* (BETTONI).- MACCHIONI, pl. 3, figs 15, 16.

Discussion: It is only a little more evolute than the holotype of *P. kurrianum* (OPPEL) refigured by FISCHER (1975; pl. 2, fig. 5), but all other morphological features are almost the same. The species are provisionally separated because the phylogeny, the variability and the ontogeny of the densely ornate, quite involute *Protogrammoceras* of the middle-upper Domerian are still unclear.
Stratigraphical distribution: Upper part of the *A. algovianum* Horizon in the *A. algovianum* Zone.
Geographical distribution: Western Tethys and North America.

Protogrammoceras meneghinii (BONARELLI, 1899)
Pl. III, fig. 6

1867-81. *Ammonites* sp. ind. MENEGHINI pl. 9, fig. 1.
1899. *Harpoceras* (?) *meneghinii* BONARELLI, p. 203.
1924. *Harpoceras denseornatum* FUCINI, pl. 7, figs 1-3.
1983. *Protogrammoceras meneghinii* (BONARELLI).- BRAGA, pl. 5, figs 11, 12, with synonymy.
v.1997b. *Paltarpites* cf. *meneghinii* (BONARELLI).- DOMMERGUES *et al.*, pl. 2, fig. 1.

2001. *Protogrammoceras meneghinii* (BONARELLI).- MACCHIONI, pl. 4, figs 1, 2, 6, 8.

Discussion: Distinction from *P. aequiondulatum* (BETTONI) is possible only by the more compressed spiral section of *P. meneghinii* (BONARELLI) which has almost discoid whorl shape and the venter is sharper.
The species is here classified following MENEGHINI's (1967-81) specimen and not that of the neotype instituted by PINNA (1969), which due to its strong prorsiradiate ribs is closer to *P. paltum* (BUCKMAN).
Stratigraphical distribution: Lower part of the *P. meneghinii* Horizon in the *A. algovianum* Zone.
Geographical distribution: East Sicily, Southern Calcareous Alps, Subbetic chain, and Umbria-Marche Apennines.

Protogrammoceras preexaratum (FUCINI, 1924)

1924. *Harpoceras preexaratum* FUCINI, pl. 5, figs 3, 4.
1978. *Argutarpites preexaratus* (FUCINI).- DUBAR & MOUTERDE, pl. 4, fig. 3.
2001. *Protogrammoceras preexaratum* (FUCINI).- MACCHIONI, pl. 3, fig. 12, pl. 4, figs 3, 7.

Discussion: The species is characterised by finer, dense ribs than *P. meneghinii* (BONARELLI) and *P. aequiondulatum* (BETTONI). Nevertheless, the general shell shape and ornamentation is similar and also in this case the separation is subtle.
Stratigraphical distribution: From the upper part of *P. solare* until the lower part of *L. naumachensis* Horizons, in the *E. emaciatum* Zone.
Geographical distribution: Betic chain, East Sicily and High Atlas.

Protogrammoceras honestum (FUCINI, 1929) *sensu* BRAGA, 1983
Pl. III, figs 3, 7

1983. *Protogrammoceras honestum* (FUCINI).- BRAGA, pl. 5, fig. 1?; pl. 6, 1.
2001. *Protogrammoceras honestum* (FUCINI) *sensu* BRAGA.- MACCHIONI, pl. 4, figs 4, 5.

Discussion: Some fragmented specimens are referred to the interpretation of BRAGA (1983), because of their coarse blunt ribs at the external half of the side whorl. They differ from FUCINI's (1929) specimens, specially that figured at pl. 12, fig. 2, in having larger and more spaced ribs.
Stratigraphical distribution: Upper part of *E. levidorsatum* to the lower *P. solare* Horizons, in the *E. emaciatum* Zone.
Geographical distribution: Betic chain and Umbria-Marche Apennines.

Protogrammoceras ilurcense BRAGA, 1983
Pl. III, figs 8, 11

1983. *Protogrammoceras ilurcense* BRAGA, pl. 5, figs 6-8.
2001. *Protogrammoceras ilurcense* BRAGA.- MACCHIONI, pl. 5, figs 9, 10.

Description: The holotype is characterised by the presence of single falcoid ribs up to 35 mm of shell diameter. After this point ribs tend to fasciculate and intercalatory ribs also develop.
Discussion: The specimen is classified in *P. ilurcense* BRAGA due to the same rib shape and density as the inner whorls of the holotype.
Stratigraphical distribution: Middle part of *A. algovianum* Horizon of the *A. algovianum* Zone.
Geographical distribution: Betic chain and Umbria-Marche Apennines.

Protogrammoceras aff. *ilurcense* BRAGA, 1983
Pl. III, fig. 13

2001. *Protogrammoceras* aff. *ilurcense* BRAGA.- MACCHIONI, pl. 4, figs 3, 4.

Discussion: Two specimens which display the same ornamental features as BRAGA's (1983) species, but differ in being more evolute and from a very different Stratigraphical position.
Stratigraphical distribution: *E. levidorsatum* Horizon of the *A. algovianum* Zone.
Geographical distribution: The specimens were collected in the Burano Gorge section (Umbria-Marche Apennines).

Protogrammoceras platyplocum (FUCINI, 1924)
Pl. III, figs 14, 18

1924. *Bassaniceras platyplocum* (GEMMELLARO).- FUCINI, pl. 16, figs 6-11.
2001. *Protogrammoceras platyplocum* (FUCINI).- MACCHIONI, pl. 5, figs 1, 2.

Type: FUCINI (1924; p. 65) attributed this species to GEMMELLARO *in schaedis*, but FUCINI made the first published description and figuration. The species is consequently attributed to FUCINI. The specimen figured by this author (FUCINI, 1924) at pl. 16, fig. 10a, b, is here selected as lectotype.
Description: Similar to the more coarsely ornate forms of *P. bassanii* (FUCINI), but differs in having a subacute venter and a sub-oval whorl section with slightly convex sides. The keel is in fact bordered by two narrow oblique areas, and not horizontal as in the holotype of *P. bassanii* (FUCINI).
Discussion: *P. bassanii* (FUCINI), *P. platyplocum*

(FUCINI) and some Toarcian specimens attributed to *P. paltum* (BUCKMAN) display the presence of a longitudinal depressed band in the internal half of the whorl side.

Stratigraphical distribution: *P. solare* and *L. serotinus* Horizons of the *E. emaciatum* Zone.

Geographical distribution: Eastern Sicily, Betic chain and Umbria-Marche Apennines.

Subgenus *Fieldingiceras* WIEDENMAYER, 1980

Type species: *Ammonites Fieldingii* REYNES, 1868.

Protogrammoceras (Fieldingiceras) fieldingii (REYNES, 1868) Pl. III, figs 9, 10

1868. *Ammonites Fieldingii* REYNES, pl. 4, fig. 1.
1893. *Harpoceras fieldingii* (REYNES).- GEYER, pl. 2, figs 1-3.
1909. *Grammoceras fieldingii* (REYNES).- ROSENBERG, pl. 15, fig. 15.
1934. *Grammoceras fieldingii* (REYNES).- MONESTIER, pl. 4, figs 28-30, 38, 39.
1980. *Leptaleoceras fieldingii* (REYNES).- WIEDENMAYER, pl. 23, figs 29, 30.
1980/81. *Fieldingia* aff. *fieldingii* (REYNES).- MOUTERDE & ROCHA, pl. 2, figs 3-6.
1981. *Fieldingia fieldingii* (REYNES).- FAURE, pl. 1, fig. 4.
1983. *Fieldingiceras fieldingii* (REYNES).- BRAGA, pl. 7, figs 3-11.
1986. *Fieldingiceras fieldingi* (REYNES).- MEISTER, pl. 22, figs 4.
1989. *Protogrammoceras (Fieldingiceras) fieldingii* (REYNES).- MEISTER, pl. 4, figs 2, 3, 5.
1990. *P. (Fieldingiceras) fieldingi* (REYNES).- DOMMERGUES *et al.*, pl. 6, fig. 7.
1991. *Fieldingiceras fieldingii* (REYNES).- FERRETTI, pl. 13, figs 6, 7.
1996. *Fieldingiceras fieldingii* (REYNES).- SMITH & TIPPER, pl. 21, fig. 3.
1998. *P. (Fieldingiceras) fieldingii* (REYNES).- GÉCZY & MEISTER, pl. 6, figs 15-17.
2001. *Fieldingiceras fieldingii* (REYNES).- MACCHIONI, pl. 4, figs 11, 12.

Discussion: Small specimens characterised by a subrectangular whorls section and evanescent, irregular sinuous ribs are unanimously referred to this species. The keel is flanked by two small flat areas. Many authors suspect that it may be a microconch of some Harpoceratinae.

Stratigraphical distribution: The specimen was collected in the *P. marianii* Horizon of the *F. lavinianum* Zone in the Burano Gorge section.

Geographical distribution: Western Tethys, North America and NW-Europe.

Genus *Fuciniceras* HAAS, 1913

Type species: *Hildoceras lavinianum* FUCINI, 1900.

Discussion: The definition of this genus as defined by HAAS (1913) is too wide, comprising species characteristic of the whole Domerian: Harpoceratinae and Arieticeratinae (FANTINI SESTINI, 1977; WIEDENMAYER, 1977; FERRETTI, 2002; DOMMERGUES *et al.*, 2002). According to SPATH (1913), *Fuciniceras* is restricted to angulirursiradiate or subangulirursiradiate forms with a more or less tricarinate ventral area. Later on, the diagnosis of *Fuciniceras* was progressively restricted and adapted to the forms typical of the lower Domerian by FANTINI SESTINI (1977) and BRAGA (1983) amongst others. Following these authors, the reduction in the peripheral segment of the ribs is the diagnostic feature of the genus *Fuciniceras*, allowing its separation from *Protogrammoceras* in which this segment is more developed (FANTINI SESTINI, 1977). We take up herein this point of view. The systematic arrangements of the species of *Fuciniceras* are taken from MACCHIONI (2001).

Stratigraphical distribution: In this study the genus is seen to occur from the *Fuciniceras costicillatum* Horizon of the *Fuciniceras costicillatum* Zone in the upper Carixian to the middle Domerian in *R. ragazzonii* Horizon at the base of the *Arieticeras algovianum* Zone.

Fuciniceras ambiguum (FUCINI, 1900) Pl. III, figs 15-17, 19-21; Pl. IV, figs 1-9

v. 1900. *Harpoceras ? ambiguum* FUCINI, pl. 7, figs 6a-c.
v. 1900. *Grammoceras portisi* FUCINI, pl. 9, figs 1-3.
1900. *Grammoceras portisi* FUCINI var. *zitteliana* FUCINI, pl. 9, figs 4.
1900. *Grammoceras Normanianum* (d'ORBIGNY) var. *inseparabilis* FUCINI pl. 8, fig. 5.
1900. *Hildoceras lavinianum* MENEGHINI var. *coniugens* FUCINI.- FUCINI, pl. 12, figs 2a-c, 3a-b.
1900. *Hildoceras Ruthenense* MENEGHINI.- FUCINI, pl. 12, figs 5a-b, 6, 7a-b.
1900. *Hildoceras intumescens* FUCINI.- FUCINI, pl. 13, figs 3a-b.
1904. *Hildoceras portisi* FUCINI.- FUCINI, pl. 20, figs 8-11, non fig. 7; pl. 21, fig. 18.
1904. *Hildoceras portisi* FUCINI var. *zitteliana* FUCINI, pl. 20, figs 12a-c, 13a-c.
1904. *Hildoceras portisi* FUCINI var. *contraria* FUCINI, pl. 20, figs 14a-b.
1904. *Hildoceras ambiguum* FUCINI.- FUCINI, pl. 21, figs 11, 12a-b; fig. 10 a-c?

1904. *Hildoceras ambiguum* FUCINI.- FUCINI, pl. 21, figs 10-12.
1904. *Hildoceras ambiguum* FUCINI var. *laevicosta* FUCINI, pl. 21, figs 13-15.
1904. *Hildoceras falciplicatum* FUCINI.- FUCINI, pl. 21, figs 19a-c.
1905. *Hildoceras lavinianum* MENEGHINI var. *coniugens* FUCINI, pl. 3, figs 10-12; pl. 5, fig. 11.
1905. *Hildoceras lavinianum* MENEGHINI var. *dissimilis* FUCINI, pl. 3, figs 13a-d, 14a-c.
1905. *Hildoceras boscense* REYNES.- FUCINI, pl. 4, figs 13a-b.
1905. *Hildoceras Bastianii* n. sp. FUCINI, pl. 4, figs 14a-b.
1905. *Hildoceras Bastianii* n. sp. (var. *perplicata*) FUCINI, pl. 3, fig. 1; pl. 4, figs 15a-b.
1908. *Hildoceras ambiguum laevicosta* FUCINI, pl. 3, figs 1-3.
1923. *Hildoceratoides laevicosta* FUCINI, pl. 11, figs 4, 5.
1923. *Hildoceras portisi* FUCINI.- FUCINI, pl. 5, fig. 13.
1923. *Hildoceratoides Lavinianum* (MENEGHINI).- FUCINI, pl. 5, fig. 1.
1923. *Hildoceratoides Lavinianum* (MENEGHINI) var. *brevispirata* (FUCINI).- FUCINI, pl. 5, fig. 2.
1923. *Hildoceratoides Lavinianum* (MENEGHINI) var. *coniugens* (FUCINI).- FUCINI, pl. 5, figs 3-5.
1967. *Fuciniceras ambiguum* (FUCINI).- CANTALUPPI, pl. 2, figs 10?, 11-13.
? 1977. *Fuciniceras ambiguum* (FUCINI).- FANTINI SESTINI, pl. 33, fig. 2.
? 1977. *Fuciniceras lavinianum coniugens* (FUCINI).- WIEDENMAYER, pl. 17, figs 14, 15.
1977. *Fuciniceras portisi portisi* (FUCINI).- WIEDENMAYER, pl. 17, figs 17?, 18, 19.
1977. *Fuciniceras portisi zittelianum* (FUCINI).- WIEDENMAYER, pl. 17, fig. 23.
? 1977. *Fuciniceras formosum* n. sp. WIEDENMAYER, pl. 17, figs 20-22.
? 1977. *Fuciniceras ambiguum laevicosta* (FUCINI).- WIEDENMAYER, pl. 17, fig. 24.
? 1980. *Fuciniceras* cf. *ambiguum* (FUCINI).- WIEDENMAYER, pl. 28, fig. 3.
? 1980. *Fuciniceras* cf. *ambiguum inaequicosta* (FUCINI).- WIEDENMAYER, pl. 10, fig. 3.
1980. *Fuciniceras lavinianum lavinianum* (FUCINI).- WIEDENMAYER, pl. 10, fig. 13.
1980. *Fuciniceras lavinianum coniugens* (FUCINI).- WIEDENMAYER, pl. 10, figs 14, 15.
1983. *Fuciniceras portisi* (FUCINI).- BRAGA, pl. 1, figs 1-5.
1983. *Fuciniceras portisi lavinianum* (FUCINI).- DOMMERGUES *et al.*, pl. 6, figs 9, 10.
1986. *Fuciniceras portisi* (FUCINI).- MOUTERDE & FERRETTI, pl. 2, figs 5-8.
1986. *Fuciniceras* gr. *portisi lavinianum* (FUCINI).- MOUTERDE & FERRETTI, pl. 2, fig. 9.
1991. *Fuciniceras portisi* (FUCINI).- FERRETTI, pl. 9, figs 4-6, non 3; pl. 10, figs 1-5.
non 1998. *Fuciniceras* gr. *ambiguum* (FUCINI).- GÉCZY & MEISTER, pl. 13, fig. 8.
1998. *Fuciniceras lavinianum* (FUCINI)-*portisi* (FUCINI); GÉCZY & MEISTER, pl. 7, fig. 7; pl. 8, figs 1, 2-6, 8-10, 3?, 7?, 11?; pl. 9, figs 3, 5, non 1, 2.
non 1998. *Fuciniceras lavinianum* (FUCINI)-*portisi* (FUCINI) var. *inclytum* (FUCINI); GÉCZY & MEISTER, pl. 7, fig. 9.
? 1998. *Fuciniceras balatonense* n. sp.; GÉCZY & MEISTER, pl. 7, figs 6, 8; pl. 17, figs 5-7.
2001. *Fuciniceras ambiguum* (FUCINI).- MACCHIONI; pl. 7, figs 4-9; 10, 11, 15, 17, 18; pl. 8, figs 1, 2, 9, 10.

Description: Form evolute to moderately involute (e.g. *Hildoceras Bastianii* var. *perplicata* FUCINI), with subrectangular or sub-trapezoidal whorl section, rounded umbilical margin and vertical wall. The venter is bisulcate, and this character is already evident at 5 mm of shell diameter. The shell is smooth up to 7·5 mm of shell diameter, after which ornamentation is provided by sigmoidal to falcoid ribs, which vary from rursiradiate to prorsiradiate. Generally the forms with rursiradiate ribs are more coarsely ornate and have more rigid ornamentation, while those with prorsiradiate ribs have less coarse ribs which tend to be falcoid (e.g. *Hildoceras ambiguum* var. *laevicosta*; FUCINI). A degree of variation exists also with regard to rib density, and morphotypes with more rursiradiate ribs are less densely ornate (e.g. *Hildoceras lavinianum* var. *coniugens* FUCINI). In the body chamber of some (probably mature) specimens, ribs are finer and tend to fasciculate and to merge with the striae (MACCHIONI, 2001).

Discussion: All transitions are observable between the above-described morphological extremes at the same stratigraphical level. They were included in the same species due to the impossibility of obtaining a morphological-stratigraphical separation; however, it is also impossible, as always in palaeontology, to be sure that they do not belong to distinct biological species whose morphologies are very similar to each other, and can thus be confused (MACCHIONI, 2001).

Based upon the holotype morphology, the concept of *F. ambiguum* (FUCINI) is an evolute form with well-spaced rectiradiate ribs. Later the same author (FUCINI, 1904; p. 294) attributes a greater morphological variability to the species, including forms that are less evolute and with finer, denser, rectiradiate to prorsiradiate ribs, which include *F. portisi* (FUCINI). The latter was des-

cribed by FUCINI (1900) nine pages after *F. ambiguum* (FUCINI), which therefore has priority.

The degree of morphological variability of this species is indeed very high, and some specimens possess morphologies that were to be adopted by other subsequent species. For example, the more involute morphotypes with ornamentation consisting of prorsiradiate falcoid ribs recall the specimens attributed here to *Protogrammoceras* aff. *bonarellii* (FUCINI). The invariant elements amongst all the above-cited morphologies are the simultaneous presence of ventral furrows, a vertical umbilical wall and the presence of sigmoidal or falcoid ribs. The association of these characters allows the separation of *F. ambiguum* (FUCINI) from the other morphologically-closer species. These are *F. costicillatum* (FUCINI), which has similar ornamentation but has an oblique umbilical wall, and *F. isseli* (FUCINI), which totally lacks ventral furrows. *F. ambiguum* var. *inaequicosta* (FUCINI, 1904; p. 295; pl. 21, figs 16-17), which has more rigid ribs, is excluded from the list of synonymies (MACCHIONI, 2001).

According to GÉCZY & MEISTER (1998), *F. balatonense* GÉCZY & MEISTER tends to be smooth in the inner half of the flank. These feature could also be related to a loss of part of the shell infilling due to pressure dissolution effects. Actually, many other ammonites belonging to different species (e.g. GÉCZY & MEISTER, 1998; pl. 7, figs 5, 9; pl. 8, fig. 1) have the same kind of preservation.

F. balatonense occurs together with *Protogrammoceras pseudodilectum* DOMMERGUES, MEISTER & FAURE, which characterises the *A. crescens* Horizon of the *Prodactylioceras davoei* Zone (DOMMERGUES *et al.*, 1997, with references therein). Presuming that the base of the Domerian Substage in the Mediterranean area corresponds with the base of the same Substage as defined in the NW-Europe, the age of *F. balatonense* GÉCZY & MEISTER is sensibly older than that of *F. ambiguum* (FUCINI). Fort this reasons *F. balatonense* GÉCZY & MEISTER is here entered in synonymy with *F. ambiguum* (FUCINI) only with reservation.

Stratigraphical distribution: *F. ambiguum* Horizon and base of the *F. lavinianum* Horizon of the *F. lavinianum* Zone.

Geographical distribution: Western Tethys.

Taxonomic remark: C. MEISTER and other authors interpreted *F. portisi* (FUCINI) and *F. lavinianum* (FUCINI) always as the *F.* gr. *lavinianum-portisi* without further distinction. Based on the interpretation of F. MACCHIONI (2001), *F. ambiguum* (FUCINI) [= *F. portisi* (FUCINI)] and *F. lavinianum* (FUCINI) are now distinguished into two groups with morphological and biostratigraphical control: *F. ambiguum* (FUCINI) is below *F. lavinianum* (FUCINI).

If the distinction in two different species is accepted, for one of us, C. MEISTER, the morphological interpretation of these two species is different, more restricted than F. MACCHIONI's interpretation:

Indeed *F. ambiguum* (FUCINI) as proposed herein includes some species or morphologies of different periods that seem not to belong to this species. For example, the Hungarian *F. balatonense* GÉCZY & MEISTER is less evolute with a smoothing of the inner half part of the flank (not due to corrosion), with coarser ribbing and a long curved rib-shape on the upper part of the flank. The Hungarian species shows some affinities (e.g. rib-strenght, umbilicus size) closer to *F. lavinianum* (FUCINI), biostratigraphically above *F. ambiguum* (FUCINI). In fact, *F. balatonense* GÉCZY & MEISTER shows rather an intermediate morphology between *P.* gr. *costicillatum* (FUCINI) and the *F. ambiguum* (FUCINI) and *F. lavinianum* (FUCINI) species. Moreover as above-mentioned, the biostratigraphical implications are important because the Hungarian species is associated with *P. pseudodilectum* DOMMERGUES, MEISTER & FAURE, *Prodactylioceras davoei* (SOWERBY) and *F. costicillatum* (FUCINI) characteristic and classic taxa from the Carixian (Davoei Zone, Capricornus Subzone) very below the Domerian *F. ambiguum* (FUCINI) and *F. lavinianum* (FUCINI).

Fuciniceras ? sp. 1
Pl. IV, figs 19-22

2001. *Fuciniceras* sp. 1, MACCHIONI, pl. 9, figs 1-4.

Description: Two specimens whose ribs are evanescent and which irregularly display fasciculation and relief. One is bisulcate (21BCF1.06) while the other (22BCF1.16; Pl. IV, fig. 22) has a sub-ogival whorl section and a sub-acute venter, without any trace of sulci.

Discussion: If we only consider their rib shape, the specimens can be attributed to *F. ambiguum* (FUCINI), whilst the kind of ornamental irregularity is closer to *P. normanianum* (D'ORBIGNY). It is noteworthy that one of the two has the same venter as *F. ambiguum* (FUCINI) (21BCF1.06), while in the other (22BCF1.16) the ventral area is the same as D'ORBIGNY's species. Specific attribution of either of these specimens is impossible at this time.

Stratigraphical distribution: *F. ambiguum* Horizon, of the *F. lavinianum* Zone.

Geographical distribution: Both specimens comes from the Burano Gorge section in the Umbria-Marche Apennines.

Fuciniceras lavinianum (MENEGHINI *in* FUCINI, 1900)
Pl. IV, figs 10-16, 18

v.1900. *Hildoceras Lavinianum* (MENEGHINI) in FUCINI, pl. 11, figs 6, 7.

v.1900. *Hildoceras Lavinianum* (MENEGHINI) var. *brevispirata* FUCINI, pl. 12, fig. 4.
1923. *Hildoceratoides Lavinianum* (MENEGHINI).- FUCINI, pl. 4, fig. 17.
1923. *Hildoceratoides Lavinianum* (MENEGHINI) var. *coniugens* (FUCINI); FUCINI, pl. 5, fig. 6.
?1980. *Fuciniceras cornacaldense* (TAUSCH).- WIEDENMAYER, pl. 10, fig. 9.
1983. *Fuciniceras lavinianum* (FUCINI).- BRAGA, pl. 1, figs 6-8; pl. 2, figs 1-3, with synonymy.
1983. *Fuciniceras brevispiratum* (FUCINI).- BRAGA, pl. 2, figs 4-9, with synonymy.
1991. *Fuciniceras portisi* (FUCINI).- FERRETTI, pl. 9, fig. 3.
1998. *Fuciniceras lavinianum* (FUCINI) - *portisi* (FUCINI) var. *inclytum* (FUCINI).- GÉCZY & MEISTER, pl. 7, fig. 9.
1998. *Fuciniceras lavinianum* (FUCINI)-*portisi* (FUCINI).- GÉCZY & MEISTER, non pl. 7, fig. 7; pl. 8, figs 3?, 7?, 11? non 1, 2-6, 8-10; pl. 9, figs 1, 2, non 3, 5.
1998. "*Fuciniceras* " gr. *isseli* (FUCINI)- *brevispiratum* (FUCINI).- GÉCZY & MEISTER, pl. 9, figs, 6, 9?, 10, non 4, 5, 7-8; pl. 10, figs 1-4, 5?, 6, 7?, non 5, 8, 9; pl. 11, fig. 2, non 1, 3.
2001. *Fuciniceras lavinianum* (FUCINI).- MACCHIONI, pl. 7, figs 12, 14, 19, 20; pl. 8, figs 3-5, 7, 13, 14

Description: The morphology of the outer whorl is very similar to that of *F. ambiguum* (FUCINI), with exception of the shape of the whorl section, which is always sub-oval rather than sub-rectangular. Striae may also be observed in the body chamber of *F. lavinianum* (FUCINI), but in contrast to *F. ambiguum* (FUCINI) ribs are truly fasciculate. At smaller shell diameters *F. lavininaum* (FUCINI) is easily recognisable from the other species of the genus due to its typical angulirursiradiate ribs. The external rib segment begins near the ventro-lateral border and is very reduced in comparison with *F. ambiguum* (FUCINI) or *F. isseli* (FUCINI). Ventral furrows appear at shell diameters ranging between 15 and 40 mm, but they are only slightly incised except in the body chamber of the larger specimens. Their appearance seems linked to a fairly clear approximation of suture lines (MACCHIONI, 2001).

Discussion: *Fuciniceras portisi* (FUCINI) [=*F. ambiguum* (FUCINI)] and *Fuciniceras lavinianum* (FUCINI) have for long time been at the centre of a systematic and nomenclatural debate. DOMMERGUES *et al.*, 1990, FERRETTI & MEISTER, 1994, and GÉCZY & MEISTER, 1998, have indicated *F. portisi* (FUCINI) - *lavinianum* (FUCINI) as the species that characterises the base of the Domerian in the Mediterranean area. This problem of attribution was inspired by FUCINI himself (1900; p. 54; pl. 12, figs 2a-c, 3a-b),who attributed the var. *coniugens* (FUCINI) to *F. lavinianum* (FUCINI) instead of to *F. portisi* (FUCINI) [=*F. ambiguum* (FUCINI)]. This prevented accurate separation of the two species, because the shell shape and morphology of this variety is within the range of variability of *F. ambiguum* (FUCINI).

On the other hand, except for BRAGA (1983), none of the authors that up today have kept *F. lavinianum* (FUCINI) and *F. portisi* (FUCINI) [=*F. ambiguum* (FUCINI)] distinct specified their separation criteria (MACCHIONI, 2001).

Stratigraphical distribution: *F. lavinianum* Horizon of the *F. lavinianum* Zone.

Geographical distribution: Betic Zone, Southern Calcareous Alps and Umbria-Marche Apennines.

Fuciniceras isseli (FUCINI, 1900)
Pl. IV, fig. 17; Pl. V, figs 1, 2

v. 1900. *Grammoceras isseli* FUCINI, pl. 9, fig. 6-8.
1968. *Fuciniceras isseli* (FUCINI).- CANTALUPPI & BRAMBILLA, pl. 29, fig. 7, 8.
1983. *Fuciniceras isseli* (FUCINI).- BRAGA, pl. 2, fig. 10; pl. 3, fig. 1-5, with synonymy.
1983. *Protogrammoceras isseli* (FUCINI).- DOMMERGUES *et al.*, pl. 4, fig. 1-12.
1991. *Protogrammoceras* gr. *isseli* (FUCINI).- BLAU & MEISTER, pl. 5, fig. 15-22.
1993. *Protogrammoceras* gr. *isseli* (FUCINI).- MEISTER & BÖHM, pl. 8, fig. 11, 14.
1995. *Protogrammoceras* gr. *isseli* (FUCINI).- DOMMERGUES *et al.*, pl. 9, fig. 6; pl. 10, fig. 4, 8.
1998. "*Fuciniceras* " gr. *isseli* (FUCINI)- *brevispiratum* (FUCINI).- GÉCZY & MEISTER, pl. 9, figs, 6, 9?, 10, non 4, 5, 7-8; pl. 10, figs 1-4, 5?, 6, 7?, non 5, 8, 9; pl. 11, fig. 2, non 1, 3.
1998. "*Fuciniceras* " gr. *isseli* (FUCINI) - *brevispiratum* (FUCINI).- GÉCZY & MEISTER, pl. 9, figs 4, 5, 7-8, non 6, 9?, 10; pl. 10, figs 8, 9, non 1-4, 5?, 6, 7??; pl. 11, figs 1, 3, non 2.
2001. *Fuciniceras isseli* (FUCINI).- MACCHIONI, pl. 8, figs 6, 8, 11, 12
? 2002a. *Fuciniceras* cf. *isseli* (FUCINI).- MACCHIONI, fig. 75, with synonymy.

Discussion: As mentioned by MACCHIONI (2001) rib shape is similar to that of *F. ambiguum* (FUCINI) but *F. isseli* (FUCINI) totally lacks ventral furrows and has finer ribs in general. *F. brevispiratum* (FUCINI) has angulirursiradiate ribs like *F. lavinianum* (FUCINI), so it can easily be separated from *F. isseli* (FUCINI).

Stratigraphical distribution: *F. isseli* Horizon of the *F. lavinianum* Zone. The species may have a wider biostratigraphical range. According to BRAGA (1983) *F. isseli* (FUCINI) can be also associated with *P. celebratum* (FUCINI). This observation is not supported herein. *F. isseli* (FUCINI) is still associated with *P.*

marianii (FUCINI) and precedes *P. celebratum* (FUCINI) stratigraphically.

Geographical distribution: Betic Zone, Southern Calcareous Alps, Upper Austroalpine of Austria and Hungary, Umbria-Marche Apennines.

Taxonomic remark: Concerning *F. lavinianum* (FUCINI) and *F. isseli* (FUCINI), the limit between these two species immediately succeeding in the stratigraphical record and which are closely related is difficult to place, mainly depending on which characters are privileged. Into the first beds with *F. isseli - brevispiratum sensu* GÉCZY & MEISTER exist some morphologies that still share some characters (e.g. tricarenate ventral part) with the underlying *F. lavinianum* (FUCINI) (concervative morphology). These forms are interpreted by F. MACCHIONI as *F. lavinianum* (FUCINI). In contrary, other morphologies show new and more derived characters like narrower and less tricarenate ventral part, often expressed in the adult stage and C. MEISTER privileges and places them inside the variability of *F. isseli* (FUCINI) group.

Fuciniceras boscense (REYNES, 1868)
Pl. V, figs 3-6

v. 1868. *Ammonites boscensi* REYNES, pl. 3, fig. 2.
1890. *Harpoceras cornacaldense* TAUSCH, pl. 1, fig. 1.
1895. *Harpoceras* ? *cornacaldense* TAUSCH var. *Bicicolae* BONARELLI, p. 339.
1934. *Fuciniceras boscense* (REYNES).- MONESTIER, pl. 2, figs 6, 13.
1934. *Fuciniceras boscense* (REYNES) var. *suejensis* MONESTIER, pl. 2, figs 10, 11.
1934. *Fuciniceras boscense* (REYNES) var. *fissa* MONESTIER, pl. 2, fig. 13.
1975. *Fuciniceras* aff. *boscense* (REYNES).- FISCHER, pl. 2, fig. 17.
1983. *Fuciniceras cornacaldense* (TAUSCH).- BRAGA, pl. 3, figs 6-8; pl. 4, fig. 1, with synonymy.
1986. *Fuciniceras suejensis* MONESTIER.- MEISTER, pl. 22, fig. 2.
1986. *Fuciniceras boscense* (REYNES).- DOMMERGUES & MEISTER, pl. 1, figs 5-11.
1991. *Fuciniceras* gr. *cornacaldense* (TAUSCH).- BLAU & MEISTER, pl. 6, figs 12-17.
1996. *Fuciniceras cornacaldense* (TAUSCH).- EL HARIRI *et al.*, pl. 71, figs 8-14.
1998. *Fuciniceras* gr. *cornacaldense* (TAUSCH).- GÉCZY & MEISTER, pl. 13, figs 6 (aff.), 10, 11.
2001. *Fuciniceras boscense* (REYNES).- MACCHIONI, pl. 9, figs 6-8.
? 2002a. *Fuciniceras* cf. *boscense* (REYNES).- MACCHIONI, fig. 74 a, non b, with synonymy.

Discussion: It is one of the most easily recognisable species of the genus, due to its high whorl covering (1/3 approx.) and the long internal rib segment. There is a certain degree of variability in the shell coiling, rib strength and density. The more coarsely and lees densely ornate forms are closer to *F. boscense* (REYNES), while *F. boscense* f. *cornacaldense* (TAUSCH) has finer, denser and more angled ribs. Finally, *F. boscense* f. *bicicolae* (BONARELLI) is one of the more involute morphotype. *F. boscense* (REYNES) has the priority of date amongst the above-cited names (MACCHIONI, 2001).

Stratigraphical distribution: The species ranges biostratigraphically from the *F. boscense* Horizon in the *F. lavinianum* Zone until the *R. ragazzonii* Horizon in the *A. algovianum* Zone.

Geographical distribution: Western Tethys and Causses basin.

Fuciniceras pectinatum (MENEGHINI, 1867-81)
Pl. V, figs 7, 8

v.1867-81. *Harpoceras pectinatum* MENEGHINI, pl. 1, figs 1-3, appendix.
1900. *Harpoceras* cf. *pectinatum* MENEGHINI.- FUCINI, pl. 7, fig. 2.
? 1900. *Harpoceras pectinatum* MENEGHINI.- DEL CAMPANA, pl. 8, figs 19, 20.
1900. *Hildoceras* (?) *pectinatum* (MENEGHINI).- BETTONI, pl. 6, figs 2, 3; pl. 8, figs 5, 6; pl. 9, fig. 7.
1905. *Hildoceras pectinatum* (MENEGHINI).- FUCINI, pl. 44, fig. 12.
1908. *Hildoceras pectinatum* (MENEGHINI).- FUCINI, pl. 3, figs 17, 18.
1909. *Harpoceras* cf. *pectinatum* (MENEGHINI).- ROSENBERG, pl. 15, fig. 23.
non 1912. *Hildoceras pectinatum* (MENEGHINI).- RENZ, pl. 6, fig. 4.
1923. *Hildoceratoides pectinatum* (MENEGHINI).- FUCINI, pl. 11, figs 2, 3.
? 1939. *Hildoceratoides* cf. *pectinatum* (MENEGHINI).- RAMACCIONI, pl. 10, fig. 12.
1962. *Protogrammoceras pectinatum* (MENEGHINI).- FANTINI SESTINI, pl. 40, fig. 12.
? 1972. "*Fuciniceras* " *pectinatum* (MENEGHINI).- FERRETTI, pl. 14, fig. 3.
1976. *Protogrammoceras pectinatum* (MENEGHINI) nov. subsp. GÉCZY, pl. 31, fig. 1.
? 1977. *Protogrammoceras pectinatum* (MENEGHINI).- FANTINI SESTINI, pl. 33, fig. 3.
1977. *Fuciniceras pectinatum* (MENEGHINI).- WIEDENMAYER, pl. 17, fig. 16.
? 1980. *Fuciniceras pectinatum* (MENEGHINI) ssp. nom. WIEDENMAYER, pl. 28, fig. 9.
? 1980. *Fuciniceras pectinatum* (MENEGHINI) *apricum* WIEDENMAYER, pl. 11, figs 1-3.

? 1986. *Protogrammoceras (Protogrammoceras) pectinatum* (MENEGHINI).- GAKOVIC, pl. 13, fig. 2.
? non1988. *Fuciniceras pectinatum* (MENEGHINI).- SMITH *et al.*, pl. 5, fig. 12.
non 1991. *Fuciniceras pectinatum* (MENEGHINI).- FERRETTI, pl. 12, fig. 2.
1998. *Fuciniceras* gr. *pectinatum* (MENEGHINI).- GÉCZY & MEISTER, pl. 13, fig. 4.
2001. *Fuciniceras pectinatum* (MENEGHINI).- MACCHIONI, pl. 9, figs 5, 13, 14.

Discussion: All specimens here attributed to this species are fragmented. The general shell morphology is similar to that of *F. boscense* (REYNES), but the latter has more angled ribs with a longer internal segment, significantly more prorsiradiate. General shell shape may also remind us of *F. isseli* (FUCINI), which lacks ventral sulci.
Stratigraphical distribution: Upper part of the *F. boscense* Horizon in the *F. lavinianum* Zone.
Geographical distribution: Southern Calcareous Alps and Umbria-Marche Apennines.

Fuciniceras aff. *pectinatum* (MENEGHINI, 1867-81)
Pl. V, figs 9, 10

2001. *Fuciniceras* aff. *pectinatum* (MENEGHINI).- MACCHIONI, pl. 9, figs 11, 12.

Description: A single specimen, finely ornamented by numerous dense, prorsiradiate, sigmoidal ribs. It is moderately involute; its whorl section is sub-elliptical and compressed, the umbilical wall is overhanging and the venter is very narrow but bisulcate. Some bullae are visible in slight relief at the middle of the whorl side.
Discussion: No other known species of the genus has this morphology and ornamentation, and the affinities with *F. pectinatum* (MENEGHINI) are slight and related to a similar rib shape, but not to their trend and strength. The compressed whorl section and the fine ribs suggests that this form may represent a link between *Fuciniceras* and the finely ornamented *Protogrammoceras* which appears in the *A. algovianum* Zone.
Stratigraphical distribution: Upper part of the *R. ragazzonii* Horizon of the *A. algovianum* Zone.
Geographical distribution: The specimen was found in the Burano Gorge section, Umbria-Marche Apennines.

Fuciniceras fontaneillesi DOMMERGUES & MEISTER, 1986
Pl. V, figs 11, 12

v. 1986. *Fuciniceras fontaneillesi* DOMMERGUES & MEISTER, pl. 1, figs 1-4
2001. *Fuciniceras fontaneillesi* DOMMERGUES & MEISTER.- MACCHIONI, pl. 9, figs 9, 10.

Description: Evolute *Fuciniceras* with sub-rectangular whorl section and bisulcate venter. The umbilical wall is convex and ribs are prorsiradiate and sigmoidal, irregular in their thickness, relief and spacing. The presence of rib reinforcement causes their tendency towards fasciculation.
Discussion: The irregular ornamentation and high convexity of the umbilical wall allows immediate distinction of this species from the others in the same genus.
The stratigraphical distribution of this species in the Apennines is partly concurrent with that of *F. boscense*, that drives to suspect that they could represent a dimorphic pair (MACCHIONI's opinion).
Stratigraphical distribution: *F. boscense* Horizon of the *F. lavinianum* Zone. In the Causses basin the species appears after *F. boscense* (DOMMERGUES & MEISTER, 1986).
Geographical distribution: Causses basin, Umbria-Marche Apennines.

Genus *Lioceratoides* SPATH, 1919

Type species: *Lioceras ? grecoi* FUCINI, 1900.

Lioceratoides exapatus (GEMMELLARO, 1885)
Pl. V, fig. 13

v.1885. *Harpoceras* (*Leioceras*) *exapatus* GEMMELLARO p. 7.
v.1929. *Praeleioceras exapatum* (GEMMELLARO).- FUCINI, pl. 19, figs 15-17.
1980. *Lioceratoides exapatus* (GEMMELLARO).- WIEDENMAYER, pl. 13, figs 9, 10.
1983. *Lioceratoides exapatus* (GEMMELLARO).- BRAGA, pl. 7, figs 12, 13, with synonymy.
2001. *Lioceratoides exapatus* (GEMMELLARO).- MACCHIONI, pl. 5, fig. 8.
2002a. *Lioceratoides exapatus* (GEMMELLARO).- MACCHIONI, figs 66 a-e, with synonymy.

Description: Only the internal rib reinforcements are preserved in the collected specimens. The majority of these are small and almost smooth except at greater diameter, where fine, evanescent ribs provide ornamentation in the final (?) part of the body-chamber.
Stratigraphical distribution: This is the oldest species referred in this work to the genus *Lioceratoides*. The specimens range from the top of *E. levidorsatum* Horizon to the lower part of *P. solare* Horizon. Following BRAGA (1983) the species also occurs in the *P. meneghinii* Horizon, but do not extend into the *P. solare* Horizon.

Geographical distribution: Betic chain, East Sicily, Umbria-Marche Apennines and probably the Southern Calcareous Alps.

Lioceratoides naumachensis (FUCINI, 1929) Pl. V, figs 14-16, 19, 20

1929. *Praeleioceras naumachense* FUCINI, pl. 14, figs 10-12.
?1980. *Lioceratoides naumachensis* (FUCINI).- WIEDENMAYER, pl. 13, figs 9, 10.
1983. *Lioceratoides naumachensis* (FUCINI).- BRAGA, pl. 7, figs 17-19, with synonymy.
2001. *Lioceratoides naumachensis* (FUCINI).- MACCHIONI, pl. 5, figs 9, 10, 13, 14.

Discussion: More or less fine and dense rectiradiate ribs are preserved at all diameters, not only in the body chamber as in *P. exapatus* (GEMMELLARO).
Stratigraphical distribution: *L. naumachensis* Horizon of the *E. emaciatum* Zone.
Geographical distribution: Betic chain, East Sicily, Umbria-Marche Apennines and probably the Southern Calcareous Alps.

Lioceratoides grecoi (FUCINI, 1900) - *loriolii* (BETTONI, 1900) Pl. V, figs 17, 18; Pl. VI, figs 1-3, 7, 8

1900. *Hildoceras*? *Loriolii* BETTONI, pl. 8, figs 11, 12.
1900. *Leioceras*? *Grecoi* FUCINI, pl. 11, figs 4, 5.
?1980. *Lioceratoides grecoi* (FUCINI).- WIEDENMAYER, pl. 14, fig 1.
1983. *Lioceratoides loriolii* (BETTONI).- BRAGA, pl. 8, figs 7-10, with synonymy.
2001. *Lioceratoides grecoi* (FUCINI) - *loriolii* (BETTONI).- MACCHIONI, pl. 5, figs 16-18.

Description: The strength of rib reinforcement is particularly remarkable in this species; this feature persists up to approximately 30 mm diameter. Rib trend changes from slightly rursiradiate to rectiradiate at small diameters, while it is slightly prorsiradiate in the bigger specimens.
Discussion: *L. loriolii* (BETTONI) and *L. grecoi* (FUCINI) were taxonomically and stratigraphically separated by BRAGA (1983). According to the author, *L. loriolii* (BETTONI) lacks the evanescent ribs that are supposed to be typical of *L. grecoi* (FUCINI).
However, a few evanescent ribs can indeed be seen at the end of the last preserved whorl of the lectotype of *L. loriolii* (BETTONI, 1900; pl. 8, fig. 12). As observed in the collected material, the most juvenile stages lack this feature, which occurs later at varying diameters.
Both names were proposed in the same year by FUCINI and BETTONI. At this time it is impossible to identify which name has priority, so they are both provisionally kept in the species designation.
Stratigraphical distribution: *L. loriolii-grecoi* Horizon of the *E. emaciatum* Zone.
Geographical distribution: Betic chain, East Sicily, Umbria-Marche Apennines and probably the Southern Calcareous Alps.

Lioceratoides serotinus (BETTONI, 1900) Pl. VI, figs 4, 12

1900. *Hildoceras*? *serotinum* BETTONI; pl. 6, figs 7, 8.
1929. *Praeleioceras aradasi* FUCINI, pl. 14, figs 1-5.
1972. *Lioceratoides serotinus* FERRETTI, pl. 14, fig. 5; pl. 15, fig. 1.
1983. *Lioceratoides aradasi* (FUCINI).- BRAGA, pl. 8, fig. 4-6, with synonymy.
?1983. *Lioceratoides serotinus* (BETTONI).- BRAGA, pl. 8, figs 1-3.
1992. *Protogrammoceras* cf. *serotinum* in WESTERMANN, pl. 17, fig. 9.
2001. *Lioceratoides serotinus* (BETTONI).- MACCHIONI, pl. 5, figs 11, 12, 15.
2002a. *Lioceratoides serotinus* (BETTONI).- MACCHIONI, figs 67 a-f, with synonymy.

Discussion: The internal-mid lateral rib reinforcements are less protruding than those of *L. loriolii* (BETTONI) - *grecoi* (FUCINI); also in *L. serotinus* (BETTONI), the falcoid ribs are always prorsiradiate and persist to a greater diameter. FUCINI (1929) and BRAGA (1983) consider as a diagnostic feature to identify *L. serotinus* (BETTONI) the presence of large, flat-topped, prorsiradiate, very closely-spaced ribs. This feature is absent both in the lectotype (BETTONI, pl. 6, fig. 7, designated by KOTTEK, 1966) and in the collected material, where ribs are fine and more widely spaced. On the other side, flat topped ribs can are be present in our specimens of *L. naumachensis* (FUCINI). Conversely *L. aradasi* (FUCINI) has the same ornamentation as the lectotype of *L. serotinus* (BETTONI). Finally *L. naumachensis* (FUCINI) differs from *L. serotinus* (BETTONI) in the lack of rib reinforcement, but their rib shape and trend are very similar.
Stratigraphical distribution: Lower part of *L. serotinus* Horizon of the top of *E. emaciatum* Subzone.
Geographical distribution: Betic chain, Eastern Sicily, Southern Calcareous Alps, Umbria-Marche Apennines and probably Upper Austroalpine in Austria, High Atlas and Siberia.

Genus *Neolioceratoides* CANTALUPPI, 1970

Type species: *Hildoceras (Lillia) Hoffmanni* GEMMELLARO, 1885.

Neolioceratoides expulsus (FUCINI, 1931) Pl. VI, figs 5, 6, 11

v. 1885. *Hildoceras (Lillia) Hoffmanni* GEMMELLARO, pl. 2, fig 12, non 11, 13, 15.
v. 1931. *Praeleioceras expulsum* FUCINI, pl. 5, figs 5:11.
non 1973. *Lioceratoides expulsus* (FUCINI).- GUEX, pl. 1, fig. 1.
? 1978. *Lioceratoides expulsus* (FUCINI).- FAUGERES, pl. 39, fig. 6.
1983. *Neolioceratoides expulsus* (FUCINI).- BRAGA, pl. 8, figs 16, 17, with synonymy.
2001. *Neolioceratoides expulsus* (FUCINI).- MACCHIONI, pl. 6, figs 1, 2.
2002a. *Neolioceratoides expulsus* (FUCINI).- MACCHIONI, fig. 69 [lectotype refigured], with synonymy.

Discussion: The species has intermediate morphology between the genus *Lioceratoides* and the more typical *Neolioceratoides*. The rib reinforcements are still clearly evident as in the first genus, but rib strength is greater and more similar to that of *Neolioceratoides*. The whorl section is sub-oval and ventral furrows are narrow and not deeply incised.
Stratigraphical distribution: From *L. naumachensis* to the *L. serotinus* Horizons of the *E. emaciatum* Zone.
Geographical distribution: Eastern Sicily, Betic chain, Umbria-Marche Apennines and probably Rif.

Neolioceratoides schopeni (GEMMELLARO, 1885) Pl. VI, figs 9, 10

v. 1885. *Hildoceras (Lillia) schopeni* GEMMELLARO, pl. 1, fig. 23; pl. 2, figs 5-7.
1983. *Neolioceratoides schopeni* (GEMMELLARO).- BRAGA, pl. 9, figs 5-8, with synonymy.
2001. *Neolioceratoides schopeni* (GEMMELLARO).- MACCHIONI, pl. 6, figs 3, 4, 6.
2002a. *Neolioceratoides schopeni* (GEMMELLARO).- MACCHIONI, fig. 72a [lectotype refigured], 72b, with synonymy.
2002. *Neolioceratoides schopeni* (GEMMELLARO).- DOMMERGUES *et al.*, p. 307, fig. 8.

Discussion: It is one of the more characteristic species of the genus, due to its sub-quadrate evolute whorls and coarse falcoid ribs.
Stratigraphical distribution: From the upper part of *L. loriolii-grecoi* Horizon of the *E. emaciatum* Zone to the lower part of *D. mirabile* Horizon in the *D. polymorphum* Zone. Data relating to the first occurrence of this species seems in agreement with that of BRAGA (1983), as *N. schopeni* (GEMMELLARO) appears below the first occurrence of *E. emaciatum* (CATULLO).
Geographical distribution: East Sicily, Betic chain, Southern Calcareous Alps, Epirus (Greece) and Umbria-Marche Apennines.

Neolioceratoides hoffmanni (GEMMELLARO, 1885) Pl. VI, figs 17, 18, 21, 22

v. 1885. *Hildoceras (Lillia) Hoffmanni* GEMMELLARO, pl. 2, figs 11, 13, 15, non 12.
1983. *Neolioceratoides hoffmanni* (GEMMELLARO).- BRAGA, pl. 9, figs 1-4, with synonymy.
? 1985. *Neolioceratoides hoffmanni* (GEMMELLARO).- COMAS RENGIFO, pl. 16, fig. 11.
2001. *Neolioceratoides hoffmanni* (GEMMELLARO).- MACCHIONI, pl. 5, fig. 5.
2002a. *Neolioceratoides hoffmanni* (GEMMELLARO).- MACCHIONI, fig. 70 a [lectotype refigured], 70 b, c, with synonymy.
2002. *Neolioceratoides hoffmanni* (GEMMELLARO).- DOMMERGUES *et al.*, p. 307, fig. 15.

Discussion: This other characteristic species has higher whorls than *N. schopeni* (GEMMELLARO), with subrectangular whorl section. *N. hoffmanni* (GEMMELLARO) also has less falcoid ribs which vary in density and strength in the upper part of the flank. *N. hoffmanni* f. *sordidum* (FUCINI) (see Pl. VI, figs 13-16) represents the more coarsely ornate morphology of the species.
Stratigraphical distribution: From the upper part of E. emaciatum Horizon of the *E. emaciatum* Zone to the lower part of *D. mirabile* Horizon in the *D. polymorphum* Zone. The first species occurrence recorded in this study confirms the one found by BRAGA (1983) in the Betic Zone.
Geographical distribution: Betic chain, Eastern Sicily, High Atlas, Southern Calcareous Alps, Umbria-Marche Apennines, Epirus (Greece) and probably the Iberian chain.

Neolioceratoides dinae (FUCINI, 1931) Pl. VI, figs 19, 20

1931. *Praeleioceras dinae* FUCINI; pl. 6, figs 26, 27.
?1980. *Neolioceratoides ballinense* (HAAS).- WIEDENMAYER, pl. 14, figs 16, 17.
1983. *Neolioceratoides dinae* (FUCINI).- BRAGA, pl. 8, fig. 15, with synonymy.
2001. *Neolioceratoides dinae* (FUCINI).- MACCHIONI, pl. 6, figs 7, 8.

Discussion: It can be distinguished from the other species of the genus by its fastigate venter and the tendency towards fasciculation of the ribs in the inner whorl. The ribs are relatively finer in general comparison with *N. schopeni* (GEMMELLARO) and *N. hoffmanni* (GEMMELLARO). The specimen develops an peri-umbilical depression observable also in *P. bassanii* (FUCINI) and *P. paltum* (BUCKMAN) among others. According to BRAGA (1983) *N. dinae* (FUCINI) and *N. expulsus* (FUCINI) represent a dimorphic pair. The specimens

figured by WIEDENMAYER (1980) are too coarsely ornate to be included in *N. ballinense* (HAAS) but the whorls are too involute to be attributed with certainty to *N. dinae* (FUCINI).

Stratigraphical distribution: One single specimen collected in the *E. emaciatum* Horizon of the *E. emaciatum* Zone.

Geographical distribution: Betic chain, Eastern Sicily, Southern Calcareous Alps, Umbria-Marche Apennines.

Neolioceratoides infidum (FUCINI, 1931)
Pl. VII, figs 4, 5

1931. *Praeleioceras infidum* FUCINI; pl. 16, figs 12-14.
? 1985. *Neolioceratoides infidum* (FUCINI).- SCHLATTER, pl. 3, fig. 4.
2001. *Neolioceratoides infidum* (FUCINI).- MACCHIONI, pl. 6, fig. 9.

Discussion: One single specimen, the morphological character of which is close to that of *N. hoffmanni* f. *sordidum* (FUCINI) except for its more evolute coiling degree and more incised ventral furrows.

Stratigraphical distribution: One single specimen found in the lower part of the *L. serotinus* Horizon of the *E. emaciatum* Zone.

Geographical distribution: Eastern Sicily, Umbria-Marche Apennines and probably Southern Germany.

Subfamily Arieticeratinae HOWARTH, 1955
Genus *Arieticeras* SEGUENZA, 1885

Type species: *Ammonites algovianus* OPPEL, 1862.

Arieticeras cf. *apertum* MONESTIER, 1934
Pl. VII, figs 1, 3

1934. *Arieticeras apertum* MONESTIER pl. 1, figs 14-16, 19.
? 1980. *Arieticeras apertum* MONESTIER.- WIEDENMAYER, pl. 18, fig. 3.
1983. *Arieticeras apertum* MONESTIER.- BRAGA, pl. 9, figs 15-18, with synonymy.
1989. *Arieticeras apertum* MONESTIER.- MEISTER, pl. 6, figs 1-5, with synonymy.
? 1996. *Arieticeras* aff. *apertum* MONESTIER.- EL HARIRI *et al.*, pl. 71, figs 15-18.
2001. *Arieticeras apertum* MONESTIER.- MACCHIONI, pl. 10, figs 1, 2.

Discussion: Not always perfectly preserved small specimens are here attributed with reservations to MONESTIER's species, essentially because of the evolute coiling.

Stratigraphical distribution: Almost unanimously this is the oldest species attributed to the genus *Arieticeras*. The specimens collected extend biostratigraphically through the whole *F. boscense* Horizon up to the lower part of the *R. ragazzonii* Horizon. In the Causses basin (MEISTER, 1989) the range of *A. apertum* MONESTIER corresponds roughly to the entire *A. subnodosus* Subzone, while in the Betic Zone (BRAGA, 1983), the species already appears in the top of *F. ambiguum* Subzone.

Geographical distribution: Western Tethys, Causses basin and Iberian chain.

Arieticeras amalthei (OPPEL, 1853)
Pl. VII, figs 2, 6-8, 10, 11

1853. *Ammonites radians amalthei* OPPEL, pl. 3, fig. 1 only.
? 1934. *Arieticeras apertum* MONESTIER, pl. 10, fig. 22.
1975. *Fuciniceras amalthei* (OPPEL).- FISCHER, pl. 2, figs 7-10.
1975. *Fuciniceras* aff. *amalthei* (OPPEL).- FISCHER, pl. 2, fig. 16.
1977. *Geczya amalthei* (OPPEL).- FANTINI SESTINI, pl. 34, figs 7-9.
1977. *Geczya* aff. *amalthei* (OPPEL).- FANTINI SESTINI, pl. 33, fig. 7.
1980. *Arieticeras amalthei* (OPPEL).- WIEDENMAYER, pl. 21, figs 3-6; pl. 29, figs 16, 17.
1983. *Arieticeras amalthei* (OPPEL).- BRAGA, pl. 9, figs 9-14 with synonymy.
1983. *Arieticeras amalthei* (MONESTIER).- BRAGA, pl. 11, figs 6, 7.
1989. *Arieticeras amalthei* (OPPEL).- MEISTER, pl. 6, fig. 7, 9, 10.
1996. *Arieticeras amalthei* (OPPEL).- EL HARIRI *et al.*, pl. 71, figs 19 (aff.), 2 (aff.), 21-24.
1998. *Arieticeras amalthei* (OPPEL).- GÉCZY & MEISTER, pl. 13, fig. 9.
2001. *Arieticeras amalthei* (OPPEL).- MACCHIONI, pl. 10, figs 3-7.

Description: This grouping includes *Arieticeras* which have less incised sulci and coarser prorsiradiate ribs which sometimes tend to fasciculate [f. *amalthei* (OPPEL) s.s.]. They are quite involute due to a great whorl height.

Discussion: Some evolute specimens figured by EL HARIRI *et al.* (1996; pl. 71, figs 23, 24), attributed to *A.* aff. *amalthei* (OPPEL), can be related to some of our forms which are characterised by evolute shells with relatively fine rectiradiate ribs and well-marked ventral furrows. Ribs are always flexuous and evanescent in the lateral-umbilical area: this allows immediate separation from *A. bertrandi* (KILIAN), which has more marked and rigid ornamentation.

Stratigraphical distribution: The species ranges from the upper half of *R. ragazzonii* Horizon to the lower part

of *A. bertrandi* Horizon in the *A. algovianum* Zone. In the Umbria-Marche Apennines, the Stratigraphical extension of some more evolute *A. amalthei* (OPPEL) is approximately half that of *A. amalthei* (OPPEL) s.s. while in the Causses basin and in the Betic chain, they follow each other stratigraphically.

Geographical distribution: Western Tethys, Causses basin and southern Germany.

Arieticeras bertrandi (KILIAN, 1889)
Pl. VII, figs 9, 13, 14, 17-19

1889. *Hildoceras Bertrandi* KILIAN, pl. 25, fig. 1 (lectotype).
1908. *Hildoceras Reynesianum* FUCINI, pl. 2, figs 19, 20.
1908. *Hildoceras Reynesi* FUCINI, pl. 2, figs 7-9.
? 1934. *Arieticeras Bertrandi* (KILIAN).- MONESTIER, pl. 9, figs 13, 19.
1934. *Arieticeras* cf. *Geyeri* (DEL CAMPANA).- MONESTIER, pl. 7, figs 26, 28; pl. 11, fig. 1.
1934. *Arieticeras ruthenense* (REYNES) var. typ.= *reynesianum* (FUCINI); MONESTIER, pl. 8, figs 12, 19.
1934. *Arieticeras algovianum* (OPPEL).- MONESTIER, pl. 7, figs 1, 2, 4, non 3.
cf. 1934. *Arieticeras* cf. *del Campanai* (FUCINI).- MONESTIER, pl. 8, fig. 15.
? 1934. *Arieticeras bettonii* (FUCINI).- MONESTIER, pl. 10, fig. 11; pl. 11, fig. 14.
1934. *Arieticeras successum* (FUCINI).- MONESTIER, pl. 8, figs 56, 59, 60.
1980. *Arieticeras reynesi* (FUCINI).- WIEDENMAYER, pl. 20, figs 13-16 with synonymy.
1980. *Arieticeras reynesianum* (FUCINI).- WIEDENMAYER , pl. 20, figs 17-20 with synonymy.
1982. *Arieticeras bertrandi* (KILIAN).- BRAGA *et al.*, pl. 2, fig. 8.
1983. *Arieticeras bertrandi* (KILIAN).- BRAGA, pl. 10, figs 8-10, non 7, with synonymy.
1984. *Arieticeras* cf. *bertrandi* (KILIAN).- CUBAYNES *et al.*, pl. 3, fig. 18.
1986. *Arieticeras (Arieticeras) bertrandi* (KILIAN).- GAKOVIC, pl. 7, fig. 3.
1986. *Arieticeras bertrandi* (KILIAN).- OUHHABI, pl. 6, figs 19, 20; pl. 8, fig. 9.
1989. *Arieticeras bertandi* forme *bertrandi* (KILIAN).- MEISTER, pl. 7, figs 1-4.
1989. *Arieticeras bertandi* forme *reynesianum* (FUCINI).- MEISTER, pl. 7, figs 5, 6.
1989. *Arieticeras bertandi* forme *reynesi* (FUCINI).- MEISTER, pl. 7, fig. 7-9.
1996. *Arieticeras bertrandi* (KILIAN).- EL HARIRI *et al.*, pl. 71, figs 25-28.
1997b. *Arieticeras* gr. *bertrandi* (KILIAN).- DOMMERGUES *et al.*, pl. 2, fig. 12.
1998. *Arieticeras* gr. *bertrandi* (KILIAN).- GÉCZY & MEISTER, pl. 14, figs 1-3.
2001. *Arieticeras bertrandi* (KILIAN).- MACCHIONI, pl. 10, figs 8-10, 12, 13
2002. *Arieticeras* gr. *bertrandi* (KILIAN).- DOMMERGUES *et al.*, p. 307, figs 9, 12.

Description: The species is characterised by slightly incised ventral furrows and nearly straight rectiradiate ribs at adult stages. At lower diameters some specimens have slightly prorsiradiate ribs, while the form *caterinae* (PARISCH & VIALE) is characterised by straight rursiradiate ribs. These are always well marked starting from the lateral-umbilical area. The specimens collected in the Burano Gorge section with larger whorl sections are characterised by coarser and more distant ribs. Except for the *A. bertrandi* f. *caterinae* (PARISCH & VIALE) (see Pl. VII, fig. 12, 15, 16) morphology, the same degree of variability was observed by MEISTER (1989) in the Causses basin.

Discussion: Like *A. amalthei* (OPPEL), all morphotypes of *A. algovianum* (OPPEL) have more flexuous ribs. *A. algovianum* (OPPEL) s.s. and *A. bertrandi* (KILIAN) s.s. are distinguished also by their rib density, which is lower in KILIAN's species.

Remarks: The shell shape and ornamentation observed seem to be under paleogeographical control. According to MEISTER (*in* DOMMERGUES *et al.*, 1989), forms with coarser and more distant ribs, compared with the Betic fauna, prevail in the Causses basin.

Stratigraphical distribution: The species extends from the *A. bertrandi* Horizon up to the *A. algovianum* Horizon in the *A. algovianum* Zone.

Geographical distribution: Western Tethys and southern part of NW-Europe area (Causses, Iberian chain).

Arieticeras algovianum (OPPEL, 1862)
Pl. VII, figs 22, 23; Pl. VIII, figs 5-8

1862. *Ammonites Algovianum* OPPEL, p. 137.
1862. *Ammonites retrorsicosta* OPPEL, p. 139.
1931. *Arieticeras almoetianum* FUCINI, pl. 8, fig. 1, non 2-4.
1984. *Arieticeras ruthenense* (REYNES).- ANTONIADIS, pl. 1, fig. 4.
1988. *Arieticeras* cf. *algovianum* (OPPEL).- SMITH *et al.*, pl. 4, figs 10, 11.
1989. *Arieticeras algovianum* form *algovianum* (OPPEL).- MEISTER, pl. 7, fig. 12, with synonymy.
1989. *Arieticeras algovianum* form *retrosicosta* (OPPEL).- MEISTER, pl. 7, fig. 10.
1989. *Arieticeras algovianum* form *almoetianum* FUCINI.- MEISTER, pl. 7, fig. 11.
1991. *Arieticeras almoetianum* FUCINI morphotypo A, B FERRETTI, pl. 12, figs 3 (?), 4; pl. 13, figs 1, 2.

1991. *Arieticeras* gr. *algovianum* (OPPEL).- BLAU & MEISTER, pl. 6, fig. 23; pl. 7, figs 1-18.
1993. *Arieticeras* gr. *algovianum* (OPPEL).- MEISTER & BÖHM, pl. 9, figs 5, 7-10.
1995. *Arieticeras* gr. *algovianum* (OPPEL).- DOMMERGUES *et al.*, pl. 10, figs 2, 3, 5-7.
? 1996. *Arieticeras* aff. *algovianum* (OPPEL).- SMITH & TIPPER, pl. 20, figs 11, 12.
1997. *Arieticeras algovianum* (OPPEL).- CASSEL, pl. 15, fig. 4.
1997b. *Arieticeras* gr. *algovianum* (OPPEL).- DOMMERGUES *et al.*, pl. 2, figs 6, 8, 9, 14.
1998. *Arieticeras* gr. *algovianum* (OPPEL).- GÉCZY & MEISTER, pl. 14, fig. 4-10; pl. 15, figs 1-3, 6.
2001. *Arieticeras algovianum* (OPPEL).- MACCHIONI, pl. 10, figs 11, 14-20.
2002. *Arieticeras* gr. *algovianum* (OPPEL).- DOMMERGUES *et al.*, p. 307, fig. 11.

Discussion: Also in this species, a wide range of variability from finer and more densely ribbed forms, like *A. algovianum* (OPPEL) s.s., to the more spaced, coarser ribbed ones, e.g. *A. algovianum* f. *retrorsicosta* (OPPEL) (see Pl. VIII, figs 1-4), was observed. They all share the same flexuous rib shape, but some are clearly bisulcate with rursiradiate ribs [f. *retrorsicosta* (OPPEL)] while in others the keel is bordered by two small flat areas and its ribs are prorsiradiate. The morphology of *A. algovianum* f. *almoetianum* (FUCINI) (see Pl. VII, figs 20, 21, 25) represents another morphological pole: it has less flexuous ribs and ventral sulci.
Stratigraphical distribution: The range of the species defines the *A. algovianum* Horizon, in the homonymous Zone. (see MEISTER, 1989).
Geographical distribution: *A. algovianum* (OPPEL) has a wide geographical distribution, and has been recorded in the western Tethys, the southern part of NW-Europe and North America.

Genus *Leptaleoceras* BUCKMAN, 1918

Type species: *Leptaleoceras leptum* BUCKMAN, 1918.

Leptaleoceras cf. *ochocoense* (IMLAY, 1968)

1968. *Protogrammoceras*? *ochocoense* IMLAY, pl. 6, figs 25-28.
1980. *Leptaleoceras* (*Leptaleoceras*) *ochocoense* (IMLAY).- WIEDENMAYER, pl. 23, figs 1, 2.
1983. *Leptaleoceras ochocoense* (IMLAY).- BRAGA, pl. 11, figs 1, 2.
2001. *Leptaleoceras* cf. *ochocoense* (IMLAY).- MACCHIONI, pl. 11, fig. 1.

Discussion: One single fragment, probably of body chamber, referred with reservations to *L. ochocoense* (IMLAY) due to its irregular ornamentation in terms of rib spacing and tendency towards fasciculation.
Stratigraphical distribution: Upper part of *R. ragazzonii* Horizon, in the lower part of the *A. algovianum* Zone of the Cerradura (b) section.
Geographical distribution: The holotype was found in North America (Alaska) and until today the species has also been found in the Betic chain and Southern Calcareous Alps.

Leptaleoceras pseudoradians (REYNES, 1868) *sensu* MONESTIER, 1934
Pl. VIII, figs 9-12

1934. *Arieticeras pseudoradians* REYNES.- MONESTIER, pl. 8, figs 61, 62, 68; pl. 11, fig. 5.
2001. *Leptaleoceras pseudoradians* (REYNES, 1868) *sensu* MONESTIER.- MACCHIONI, pl. 11, figs 3, 4.

Description: The specimens collected show a sub-rectangular compressed whorl section; the keel is bordered by two small flat areas, transforming into narrow sulci during ontogeny. Ribs are straight and projected, from rectiradiate to slightly prorsiradiate; they are normally denser and finer in the inner whorls.
Discussion: The species is considered in line with MONESTIER's (1934) interpretation. Due to the presence of ventral furrows and a sub-rectangular spiral section, the specimens differ both from the holotype of *L. pseudoradians* (REYNES, 1868; pl. 1, fig. 4) and from that of *L. ochocoense* (IMLAY, 1968, pl. 6, figs 27-28), where a trend in diminishing rib density during growth can be observed. Rib shape is also similar to that of *A. bertrandi* f. *caterinae* (PARISCH & VIALE) which has still thicker sides.
Stratigraphical distribution: The specimens comes from the *A. bertrandi* Horizon, in the *A. algovianum* Zone.
Geographical distribution: Causses basin and Umbria-Marche Apennines.

Leptaleoceras ugdulenai (GEMMELLARO, 1885)
Pl. IX, figs 1-9, 12

v. 1885. *Arieticeras* (*Grammoceras*) *ugdulenai* GEMMELLARO, p. 6.
1929-30. *Seguentia ugdulenai* (GEMMELLARO).- FUCINI, pl. 15, figs 1-7.
1929-30. *Seguentia ugdulenai* (GEMMELLARO) *denseplicata* FUCINI, pl. 15, figs 8, 9.
1929-30. *Seguentia ugdulenai* (GEMMELLARO) *rareplicata* FUCINI, pl. 15, figs 10-13.
1929-30. *Seguentia* ? *insignis* FUCINI, pl. 15, figs 20, 21.
? 1931. *Seguentia parodii* FUCINI, pl. 9, figs 17-19.

1934. *Arieticeras lozeriense* MONESTIER, pl. 9, figs 8-11, 14-17, ? 18; pl. 11, fig. 4.
? 1967. *Canavaria ugdulenai* (GEMMELLARO).- BARBERA, pl. 5, fig. 11.
1968. *Canavaria insignis* (FUCINI).- CANTALUPPI & BRAMBILLA, pl. 27, fig. 14.
1968. *Canavaria ugdulenai* (GEMMELLARO).- CANTALUPPI & BRAMBILLA, pl. 28, fig. 3.
1972. "*Seguentia*" *ugdulenai* (GEMMELLARO).- FERRETTI, pl. 14, fig. 4.
1977. *Ugdulenaia ugdulenai* (GEMMELLARO).- FANTINI SESTINI, pl. 38, figs 1-5.
1980. *Leptaleoceras ugdulenai* (GEMMELLARO).- WIEDENMAYER, pl. 22, figs 25, 26; pl. 23, figs 16-22.
1981. *Ugdulenaia ugdulenai* (GEMMELLARO).- FANTINI SESTINI *et al.*, pl. 1, fig. 2.
1983. *Leptaleoceras insigne* (FUCINI).- BRAGA, pl. 11, figs 3-5.
1983. *Arieticeras ugdulenai* (GEMMELLARO).- BRAGA, pl. 11, figs 8-15 with synonymy.
1986. *Ugdulenia ugdulenai* (GEMMELLARO).- GAKOVIC, pl. 8, fig. 3.
1989. *Arieticeras ugdulenai* (GEMMELLARO).- MEISTER, pl. 6, figs 15, 17.
1991. *Ugdulenia ugdulenai* (GEMMELLARO) morphotypes A, B FERRETTI, pl. 13, figs 3-5.
1991. *Arieticeras* gr. *ugdulenai* (GEMMELLARO).- BLAU & MEISTER, pl. 6, figs 19-22.
1998. "*Leptaleoceras*" aff. *ugdulenai* (GEMMELLARO).- GÉCZY & MEISTER, pl. 15, figs 8, 10.
1998. *Leptaleoceras* gr. *insigne* (FUCINI).- GÉCZY & MEISTER, pl. 15, fig. 7, 9; pl. 16, figs 1-4, 6.
2001. *Leptaleoceras ugdulenai* (GEMMELLARO).- MACCHIONI, pl. 11, figs 11-13, 15, 16.
2002a. *Leptaleoceras ugdulenai* (GEMMELLARO).- MACCHIONI, fig. 78a [Neotype refigured], 78b, c.
2002. *Leptaleoceras ugdulenai* (GEMMELLARO).- DOMMERGUES *et al.*, p. 307, figs 6, 7.

Description: Relatively involute shells with sub-elliptical compressed whorl section, low vertical umbilical wall and rounded margin. The venter is not sulcate and two *meplats* (small flat areas) border the high, well-differentiated keel. The ornamentation is made up of straight rectiradiate ribs reinforced near the ventro-lateral border, typical of *L. ugdulenai* f. *insigne* (FUCINI) (see Pl. VIII, figs 13-17), or slightly flexuous ribs which maintain their width along the side, as in the holotype of *L. ugdulenai* (GEMMELLARO).

Discussion: Distinction between the two forms is very subtle, and furthermore all transitions are observable between the two end-forms that are found in association in the Burano Gorge section. However, these two forms are considered to pertain to different species, succeeding each other, in the phyletic scheme presented by BRAGA (1983).

Stratigraphical distribution: *L. ugdulenai* Horizon, in the *A. algovianum* Zone.

Geographical distribution: Western Tethys, Causses basin.

Leptaleoceras accuratum (FUCINI, 1931)
Pl. IX, figs 10, 11, 13-15, 20, 21

1931. *Arieticeras* (?) *accuratum* FUCINI, pl. 8, fig. 7, 8.
non 1952. *Arieticeras accuratum* FUCINI.- VENZO, pl. A, figs 8, 9.
1968. *Arieticeras accuratum* FUCINI.- CANTALUPPI & BRAMBILLA, pl. 27, fig. 1.
1977. *Ugdulunia accurata* (FUCINI).- FANTINI SESTINI, pl. 37, fig. 7; pl. 38, figs 7, 8; pl. 39, figs 1-9.
1980. *Arieticeras accuratum* FUCINI.- WIEDENMAYER , pl. 17, figs 15-18.
1982. *Leptaleoceras accuratum* (FUCINI).- BRAGA *et al.*, pl. 3, fig. 1.
1983. *Leptaleoceras accuratum* (FUCINI).- BRAGA, pl. 12, fig. 3-10.
1983. *Leptaleoceras accuratum* (FUCINI) f. *preaccuratum* BRAGA; pl. 11, figs 27-30; pl. 12, figs 1, 2.
1985. *Arieticeras accuratum* FUCINI.- COMAS RENGIFO, pl. 16, figs 1, 2.
1986. *Arieticeras (Arieticeras) accuratum* (FUCINI).- GAKOVIC, pl. 6, fig. 1.
? 1988. *Leptaleoceras* aff. *accuratum* (FUCINI).- SMITH *et al.*, pl. 4, fig. 9.
1992. *Leptaleoceras* aff. *accuratum* (FUCINI).- THOMPSON & SMITH, pl. 13, figs 6, 8, 9.
1994. *Leptaleoceras* aff. *accuratum* (FUCINI).- PALFY & HART, pl. 1, fig. 11.
1995. *Leptaleoceras* aff. *accuratum* (FUCINI).- DOMMERGUES *et al.*, pl. 10, figs 9-11.
1996. *Leptaleoceras* aff. *accuratum* (FUCINI).- SMITH & TIPPER, pl. 22, figs 1-6.
1997. *Leptaleoceras* gr. *accuratum* (FUCINI).- DOMMERGUES *et al.*, pl. 2, figs 11, 25.
1998. *Leptaleoceras* gr. *accuratum* (FUCINI).- GÉCZY & MEISTER, pl. 15, fig. 4.
1998. *Leptaleoceras accuratum preaccuratum* BRAGA.- GÉCZY & MEISTER, pl. 15, fig. 5.
2001. *Leptaleoceras accuratum* (FUCINI).- MACCHIONI, pl. 11, figs 7, 10-14.

Description: This group is composed of shells with the whorl section changing from sub-elliptic to sub-rectangular, always compressed, during growth. Consequently the venter is keeled and shouldered at lower diameters, while at larger diameters two narrow, somewhat depressed flat areas are observed. The rib shape also changes

during growth: they are rectiradiate or prorsiradiate and pass from flexuous to straight and projected at the ventro-lateral border. *L. accuratum* f. *preaccuratum* BRAGA (see Pl. IX, figs 16, 17, 19, 22, 25, 26) and *L. accuratum* (FUCINI) probably represent a dimorphic pair – they share the same variation in shell shape and ornamentation during ontogeny. They were nevertheless separated when taking in account their different coiling degree, which is higher in *L. accuratum* (FUCINI), was taken into account. Specimen 161BCF9,12 is the biggest one attributed to *L. accuratum* f. *preaccuratum* BRAGA: it shows a marked uncoiling tendency in the last preserved part of the body chamber and has very approximate suture lines.

The shell in *L. ugdulenai* (GEMMELLARO) is in general more involute than that of *L. accuratum* (FUCINI), and moreover at greater diameters its venter is always more pinched. The inner whorls of *L. accuratum* (FUCINI) are also larger and/or more evolute.

Stratigraphical distribution: Both forms have the same stratigraphical range, which is the lower half of *A. algovianum* Horizon of the *A. algovianum* Zone.

Geographical distribution: North America, Western Tethys and Iberian chain.

Leptaleoceras? sp. 1
Pl. IX, figs 23, 24

2001. *Leptaleoceras* sp. 1, MACCHIONI, pl. 11, figs 5, 6.

Description: A single specimen in which ribs are gently flexuous and fasciculate in the inner whorls and straight and projected at the ventro-lateral border, single, slightly rursiradiate in the last preserved half whorl. In the last covered whorl, the venter is sub-acute, whereas in the outer the venter is bisulcate and carinate.

Discussion: The specimen is referred to the genus *Leptaleoceras* because of the fasciculate ribs.

Stratigraphical position: The specimen was found in the middle part of the upper half of the *A. algovianum* Horizon, above the last occurrence of *L. accuratum* (FUCINI), in the *A. algovianum* Zone.

Geographical distribution: The exemplar comes from the Burano Gorge section.

Leptaleoceras sp. juv. cf. sp. 1 *sensu* BRAGA, 1983
Pl. IX, fig. 18

1983. *Leptaleoceras* sp. 1 BRAGA, pl. 12, figs 11, 12.
2001. *Leptaleoceras* sp. juv. cf. sp. 1 *sensu* BRAGA.- MACCHIONI, pl. 11, fig. 2.

Discussion: Small *Leptaleoceras* characterised by irregularly-spaced ribs, as in BRAGA's (1983) specimens. This kind of ornamentation recalls that of *Fieldingiceras fieldingii* (FUCINI).

Stratigraphical distribution: It was found at the top of *L. ugdulenai* Horizon in *A. algovianum* Zone.

Geographical distribution: Burano Gorge section.

Genus *Fontanelliceras* FUCINI, 1931

Type species: *Harpoceras fontanellense* GEMMELLARO, 1885.

Fontanelliceras perspiratum (FUCINI, 1909)

1909. *Hildoceras perspiratum* FUCINI, pl. 2, fig. 1.
1929-30. *Arieticeras perspiratum* (FUCINI).- FUCINI, pl. 7, figs 5-8.
? 1934. *Arieticeras perspiratum* (FUCINI).- MONESTIER, pl. 7, figs 7-10.
non 1980. *Arieticeras perspiratum* (FUCINI).- WIEDENMAYER, pl. 20, figs 9-12.
1983. *Fontanelliceras perspiratum* (FUCINI).- BRAGA, pl. 13, fig. 1.
? 1992. *Fontanelliceras* cf. *fontanellense* (GEMMELLARO).- in WESTERMANN, pl. 17, fig. 10.
2001. *Fontanelliceras perspiratum* (FUCINI).- MACCHIONI, pl. 12, fig. 1.

Discussion: Differs from *F. fontanellense* (GEMMELLARO) in having finer, denser ribs.

Stratigraphical distribution: *L. naumachensis* Horizon, in the *E. emaciatum* Zone.

Geographical distribution: Southern Calcareous Alps, Betic chain, East Sicily.

Fontanelliceras fontanellense (GEMMELLARO, 1885)
Pl. X, figs 1, 4

v. 1885. *Harpoceras Fontanellense* GEMMELLARO, pl. 2, figs 1, 2.
1899. *Fontanelliceras juliae* (BONARELLI).- FUCINI, pl. 24, figs 5a-d.
1900. *Hildoceras* (*Arieticeras*) *fontanellense* (GEMMELLARO).- BETTONI, pl. 5, figs 10, 12.
1900. *Hildoceras* (*Arieticeras*) *juliae* (BONARELLI).- BETTONI, pl. 5, fig. 14.
1908. *Hildoceras fontanellense* (GEMMELLARO).- FUCINI, pl. 1, fig. 24; pl. 2, figs 41-45.
? 1913. *Arietites* (*Vermiceras*) *fontanellensis* (GEMMELLARO).- HAAS, pl. 3, figs 1, 2.
1931. *Fontanelliceras fontanellense* (GEMMELLARO).- FUCINI, pl. 8, figs 21-26.
1931. *Fontanelliceras juliae* (BONARELLI).- FUCINI, pl. 8; figs 28-31.
non 1934. *Arieticeras fontanellense* (GEMMELLARO).- MONESTIER, pl. 10, figs 48-52; pl. 11, fig. 9.

1968. *Fontanelliceras fontanellense* (GEMMELLARO).- CANTALUPPI & BRAMBILLA, pl. 28, figs 4, 5.
? 1968. *Fontanelliceras* cf. *fontanellense* (GEMMELLARO).- IMLAY, pl. 36, figs 16-18.
1972. *Fontanelliceras juliae* (BONARELLI).- FERRETTI, pl. 17, fig. 2.
1973. *Fontanelliceras fontanellense* (GEMMELLARO).- GUEX, pl. 6, fig. 2.
1977. *Fontanelliceras fontanellense* (GEMMELLARO).- FANTINI SESTINI, pl. 33, figs 5, 6.
1980. *Fontanelliceras fontanellense* (GEMMELLARO).- WIEDENMAYER, pl. 21, figs 18-21.
1980. *Fontanelliceras juliae* (BONARELLI).- WIEDENMAYER, pl. 21, figs 22, 23.
? 1981. *Fontanelliceras* cf. *fontanellense* (GEMMELLARO).- IMLAY, pl. 11, figs 17-23.
1983. *Fontanelliceras fontanellense* (GEMMELLARO).- BRAGA, pl. 12, figs 13-15.
2001. *Fontanelliceras fontanellense* (GEMMELLARO).- MACCHIONI, pl. 12, figs 2, 3.
2002a. *Fontanelliceras fontanellense* (GEMMELLARO).- MACCHIONI, fig. 88a [Lectotype refigured], 88 b.

Discussion: *F. fontanellense* (GEMMELLARO) is a group characterised by coarse rectiradiate or rursiradiate ribs (clavate) and a sub-rectangular depressed whorl section, with a bisulcate, tri-carinate venter.
Stratigraphical distribution: From *L. lorioli-grecoi* Horizon, in the *E. emaciatum* Zone of the upper Domerian, up to the *D. mirabile* Horizon in the Lower Toarcian.
Geographical distribution: Western Tethys, North America and Japan.

Genus *Emaciaticeras* FUCINI, 1931

Type species: *Ammonites emaciatus* CATULLO, 1853.

Emaciaticeras cf. *speciosum* (FUCINI, 1931)

1931. *Naxensiceras speciosum* FUCINI, pl. 18, figs 44-46.
? 1967. *Naxensiceras speciosum* FUCINI.- FERRETTI, pl. 64, fig. 6.
1983. *Emaciaticeras speciosum* (FUCINI).- BRAGA, pl. 13, figs 9-13, with synonymy.
2001. *Emaciaticeras* cf. *speciosum* (FUCINI).- MACCHIONI, pl. 12, fig. 4.

Description: One single specimen, fragmented and deformed, which has dense fine flexuous ribs that may be fasciculate, is referred to this species with reservations.
Stratigraphical distribution: *E. levidorsatum* Horizon?, *A. algovianum* or *E. emaciatum* Zones?
Geographical distribution: East Sicily, Betic zone, Southern Calcareous Alps, Umbria-Marche Apennines.

Emaciaticeras imitator FUCINI, 1931
Pl. X, fig. 2

1931. *Emaciaticeras imitator* FUCINI, pl. 14, figs 2, 3.
1983. *Canavaria* (*Emaciaticeras*) *imitator* (FUCINI).- WIEDENMAYER, pl. 25, figs 1-4.
1983. *Emaciaticeras imitator* FUCINI.- BRAGA, pl. 13, figs 17-24.
1985. *Emaciaticeras* cf. *imitator* FUCINI.- COMAS RENGIFO, pl. 18, fig. 8.
2001. *Emaciaticeras imitator* FUCINI.- MACCHIONI, pl. 12, fig. 6.

Discussion: *Emaciaticeras imitator* FUCINI differs from *E. speciosum* (FUCINI) in having more rigid ribs, slightly reinforced near the ventro-lateral border. However, they share nearly the same rib density, and in both species ribs reach the ventral area.
Stratigraphical distribution: Base of *E. emaciatum* Horizon in the *E. emaciatum* Zone.
Geographical distribution: Betic Zone, East Sicily, Iberian chain; Southern Calcareous Alps, Umbria-Marche Apennines.

Emaciaticeras emaciatum (CATULLO, 1853)
Pl. X, figs 3, 5-10, 15

1853. *Ammonites emaciatus* CATULLO, pl. 4, fig. 2.
1931. *Emaciaticeras fervidum* FUCINI, pl. 13, figs 2, 3.
1967. *Emaciaticeras emaciatum* (CATULLO).- FERRETTI, pl. 64, fig. 4.
1967. *Emaciaticeras fervidum* FUCINI.- FERRETTI, pl. 64, fig. 5.
1968. *Arieticeras emaciatum* (CATULLO).- CANTALUPPI & BRAMBILLA, pl. 27, figs 7, 8.
1970. *Emaciaticeras fervidum* FUCINI.- FERRETTI, pl. 35, fig. 1, 2.
1972. *Emaciaticeras fervidum* FUCINI.- FERRETTI, pl. 15, fig. 6; pl. 16, fig. 1.
1980. *Canavaria* (*Emaciaticeras*) *emaciata* (CATULLO).- WIEDENMAYER, pl. 24, figs 11-14.
1980. *Canavaria* (*Emaciaticeras*) *fervida* (FUCINI).- WIEDENMAYER, pl. 24, figs 15 ?, 16, 17.
1983. *Emaciaticeras emaciatum* (CATULLO).- BRAGA, pl. 13, figs 28-31; pl. 14, fig. 1, with synonymy.
1985. *Emaciaticeras emaciatum* (CATULLO).- COMAS RENGIFO, pl. 18, figs 5-7.
1997b. *Emaciaticeras emaciatum* (CATULLO).- DOMMERGUES *et al.*, pl. 2, fig. 26.
1998. *Emaciaticeras* gr. *fervidum* FUCINI.- GÉCZY & MEISTER. pl. 16, fig. 7.

2001. *Emaciaticeras emaciatum* (CATULLO).- MACCHIONI, pl. 12, figs 7, 8, 13, 14.

Discussion: This well-known species is characterised by straight, slightly rursiradiate ribs which are evanescent at the ventro-lateral border. A continuous degree of rib density and thickness was observed. Consequently *E. fervidum* FUCINI represents the more coarsely-ornamented morphologic pole of this variability. Ribs do not reach the ventro-lateral border in *E. archimedis* FUCINI, but in *E. imitator* FUCINI they still preserve the ventral projection. In the latter, ribs are also more flexuous, finer and denser.
Stratigraphical distribution: Lower part of *E. emaciatum* Horizon in the *E. emaciatum* Zone.
Geographical distribution: Betic Zone, Iberian chain; Southern Calcareous Alps, Umbria-Marche Apennines and probably High Atlas.

Emaciaticeras archimedis FUCINI, 1931
Pl. X, fig. 11-14, 19, 20

1931. *Emaciaticeras archimedis* FUCINI; pl. 12, figs 20-23.
1980. *Canavaria* (*Emaciaticeras*) *archimedis* (FUCINI).- WIEDENMAYER, pl. 30, figs 19, 20.
1983. *Emaciaticeras archimedis* FUCINI.- BRAGA, pl. 14, figs 2-4, with synonymy.
2001. *Emaciaticeras archimedis* FUCINI.- MACCHIONI, pl. 12, figs 5, 9, 11, 12.

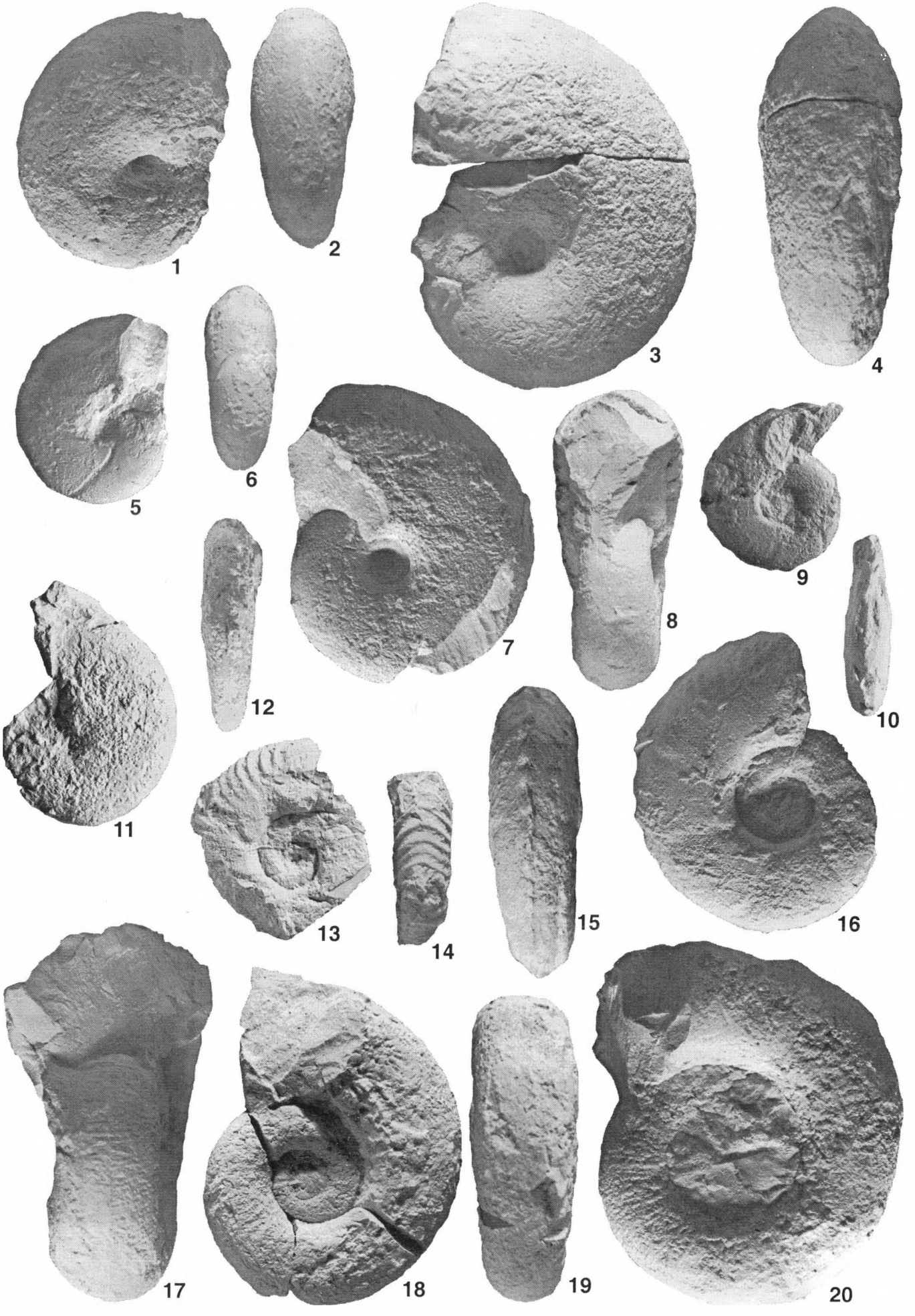
Discussion: Taking into account their Stratigraphical relationship, a clear trend of smoothing the external part of the ribs can be observed from *E. emaciatum* (CATULLO) and *E. archimedis* FUCINI; in the latter, indeed, ribs do not reach the ventro-lateral border. Also in FUCINI's species a continuous variation in rib density and thickness is observable. Compared with *E. emaciatum* (CATULLO), *E. archimedis* FUCINI may have finer, denser ribs.
Stratigraphical distribution: Upper part of *E. emaciatum* Horizon in the *E. emaciatum* Zone.
Geographical distribution: Betic Zone, eastern Sicily, Southern Calcareous Alps, Umbria-Marche Apennines.

Emaciaticeras timaei (GEMMELLARO, 1885)
Pl. X, figs 17, 18, 21

1885. *Harpoceras* (*Grammoceras*) *timaei* GEMMELLARO, pl. 1, figs 10-13.
1900. *Harpoceras*? *timaei* GEMMELLARO.- BETTONI, pl. 8, fig. 13.
1900. *Naxensiceras timaei* (GEMMELLARO).- FUCINI; pl. 18, figs 7, 8, 13, 14.
1980. *Leptaleoceras* (*Leptaleoceras*) *timaei* (GEMMELLARO).- WIEDENMAYER, pl. 30, fig. 14.
1983. *Emaciaticeras timaei* (GEMMELLARO).- BRAGA, pl. 14, figs 5-9, with synonymy.
2001. *Emaciaticeras timaei* (GEMMELLARO).- MACCHIONI, pl. 12, figs 15, 16.
2002a. *Emaciaticeras timaei* (GEMMELLARO).- MACCHIONI, fig. 86a [Lectotype refigured]-d.

Plate I

Figs 1-4: *Phylloceras hebertinum* (REYNES)
A. algovianum Zone, 1, 2: 321BCF6.46
F. lavinianum Zone, 3, 4: 318BCF2.10.
Figs 5, 6: *Calliphylloceras bicicolae* (MENEGHINI)
A. algovianum Zone, 313BCF12.45.
Figs 7, 8: *Calaiceras calais* (MENEGHINI)
F. lavinianum Zone, 319BCF5.92.
Figs 9, 10: *M.* (*Harpophylloceras*) *eximium* (HAUER)
E. emaciatum Zone, 303BCF15.65
Figs 11, 12: *Zetoceras*? sp. ind.
E. emaciatum Zone, 326BCF15.00.
Figs 13, 14: *M .*(*Juraphyllites*) *libertum* (GEMMELLARO)
A. algovianum Zone, 292BCF9.76.
Figs 15, 16: *M.* (*Meneghiniceras*) *lariense* (MENEGHINI)
E. emaciatum Zone, 316BCF16.04.
Figs 17, 20: *Lytoceras baconicum* VADASZ
F. lavinianum Zone, 325BCF4.25.
Figs 18, 19: *Lytoceras fimbriatum* (SOWERBY) - *villae* MENEGHINI
F. lavinianum Zone, 312BCF3.63.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Discussion: Small *Emaciaticeras* characterised by the presence of irregularities in rib spacing and thickness.
Stratigraphical distribution: Upper part of *E. emaciatum* Horizon and lower half of *L. serotinus* Horizon of the *E. emaciatum* Zone.
Geographical distribution: Betic Zone, eastern Sicily, Southern Calcareous Alps, Umbria-Marche Apennines.

Emaciaticeras retroplicatum FUCINI, 1931
Pl. X, fig. 22

1931. *Emaciaticeras retroplicatum* FUCINI, pl. 12, figs 1-3.
1931. *Emaciaticeras reverseplicatum* FUCINI, pl. 12, figs 7-10.
1978. *Emaciaticeras* sp. (gr. *reverseplicatum-oblique-plicatum*) (FUCINI).- FAUGERES, pl. 41, fig. 11.
1980. *Canavaria* (*Emaciaticeras*) *retroplicata* (FUCINI).- WIEDENMAYER, pl. 30, fig. 24.
1980. *Canavaria* (*Emaciaticeras*) *reverseplicata* (FUCINI).- WIEDENMAYER, pl. 25, fig. 19; pl. 26, figs 1-2.
2001. *Emaciaticeras retroplicatum* FUCINI.- MACCHIONI, pl. 12, fig. 10.

Discussion: Similar to *E. emaciatum* (CATULLO) in rib shape, but differs from it in having strong rursiradiate ribs. No real differences are observable between *E. reverseplicatum* FUCINI and *E. retroplicatum* FUCINI, which has page priority.
Stratigraphical distribution: Lower part of *L. serotinus* Horizon of the *E. emaciatum* Zone.
Geographical distribution: Eastern Sicily, Southern Calcareous Alps, Umbria-Marche Apennines.

Genus *Canavaria* GEMMELLARO, 1886

Type species: *Harpoceras* (*Dumortieria*) *haugi* GEMMELLARO, 1885, designated by HOWARTH (1955).

Canavaria zancleana (FUCINI, 1931)
Pl. X, fig. 16

1931. *Emaciaticeras zancleanum* FUCINI, pl. 11, figs 13-18.
1980. *Canavaria* (*Emaciaticeras*) *zancleana* (FUCINI).- WIEDENMAYER, pl. 26, figs 3-6.
1983. *Canavaria* (*Canavaria*) *zancleana* (FUCINI).- BRAGA, pl. 14, figs 13-15.
1985. *Emaciaticeras zancleanum* FUCINI.- COMAS RENGIFO, pl. 18, fig. 2.
2001. *Canavaria zancleana* (FUCINI).- MACCHIONI, pl. 12, fig. 18.

Discussion: Small fragment with straight rursiradiate ribs and a tubercle located at the ventro-lateral border.
Stratigraphical distribution: Middle part of *L. serotinus* Horizon of the *E. emaciatum* Zone.
Geographical distribution: Betic Zone, eastern Sicily, Iberian chain, Southern Calcareous Alps, Umbria-Marche Apennines.

CONCLUSION

The taxonomic analysis and the detailed biostratigraphical framework achieved herein, obviously show that the Gola del F. Burano Section(Apennine) can be considered as a reference section for the Domerian of the

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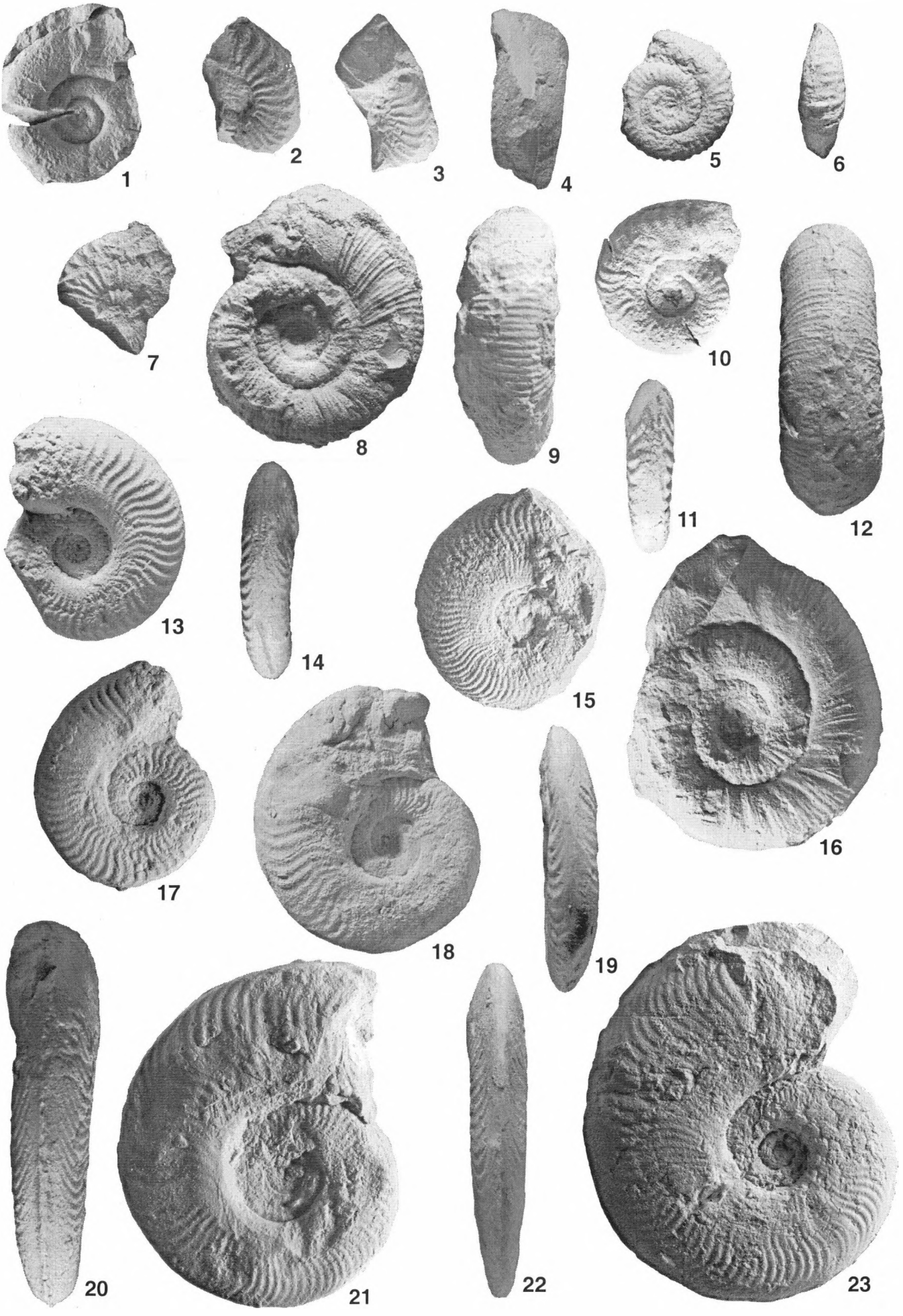
Plate II

Fig. 1: *Audaxlytoceras grandonense* (MENEGHINI)
D. polymorphum Zone, 304BCF17.56.
Figs 2, 3, 4, 7: *Pleuroceras solare* (PHILLIPS)
E. emaciatum Zone, 2: E282BCF14.85, 3, 4: 288BCF14.85, 7: 290BCF14.85.
Figs 5, 6: *Reynesoceras ragazzonii* (HAUER)
A. algovianum Zone, 397BCF6.44.
Figs 8, 9, 12, 16: *Reynesoceras ragazzonii* f. *acanthoides* (REYNES)
A. algovianum Zone, 8, 9: 391BCF6.47, 12, 16: 390BCF6.51.
Figs 10, 11: *Protogrammoceras* aff. *bonarellii* (FUCINI)
F. lavinianum Zone, 293BCF2.12.
Figs 13, 14, 17: *Protogrammoceras marianii* (FUCINI)
F. lavinianum Zone, 13, 14: 294BCF2.12, 17: 297BCF2.12.
Figs 18, 19, 21, 22: *Protogrammoceras celebratum* (FUCINI)
F. lavinianum Zone, 18, 19: 331BCF2.40, 21, 22: 329BCF2.38.
Figs 15, 19, 20, 23: *Protogrammoceras aequiondulatum* (BETTONI)
A. algovianum Zone, 15, 19: 171BCF9.58, 20, 23: 173BCF9.50.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Tethyan Realm. The ammonite biostratigraphical succession provided (e.g. *F. ambiguum*, *F. lavinianum* and *F. isseli* Horizons for the base of the Domerian) seems to be one of the most complete and detailed fossil record known in the Tethyan area. This allowed us to construct the first high resolution biostratigraphical scale for the study period based on Tethyan taxa. Only the presence of *Pleuroceras solare* (PHILLIPS) allows direct correlations with the NW European archipelago. A complete analysis of the biostratigraphy and correlations will be given in part five.

The taxonomic results obtained were subsequently used to study the fossils collected in the other two sections. The homogeneity of the systematic approach enhances the importance of the biostratigraphical framework obtained for the Umbria-Marche Apennines and the Subbetic areas.

ACKNOWLEDGEMENTS

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Plate III

Figs 1, 2, 4, 5: *Protogrammoceras aequiondulatum* (BETTONI)
A. algovianum Zone, 1, 2: 175BCF9.57, 4, 5: 174BCF9.58.

Figs 3, 7: *Protogrammoceras honestum* (FUCINI, 1929) *sensu* BRAGA
A. algovianum Zone, 3: 448BCF13.86, 7: 451BCF14.26.

Fig. 6: *Protogrammoceras meneghinii* (BONARELLI)
A. algovianum Zone, 271BCF11.33.

Figs 8, 11: *Protogrammoceras ilurcense* BRAGA
A. algovianum Zone, 170BCF9.55.

Figs 9, 10: *P. (Fieldingiceras) fieldingii* (REYNES)
F. lavinianum Zone, 325BCF1.12.

Fig. 13: *Protogrammoceras* aff. *ilurcense* BRAGA
A. algovianum Zone, 209BCF13.68.

Figs 14, 18: *Protogrammoceras platyplocum* (FUCINI)
E. emaciatum Zone, 180BCF17.18.

Figs 15-17, 19-21: *Fuciniceras ambiguum* (FUCINI)
F. lavinianum Zone, 15, 16: 351BCF1.18, 17, 21: 350BCF1.09; 19, 20: 379-378BCF1.17.

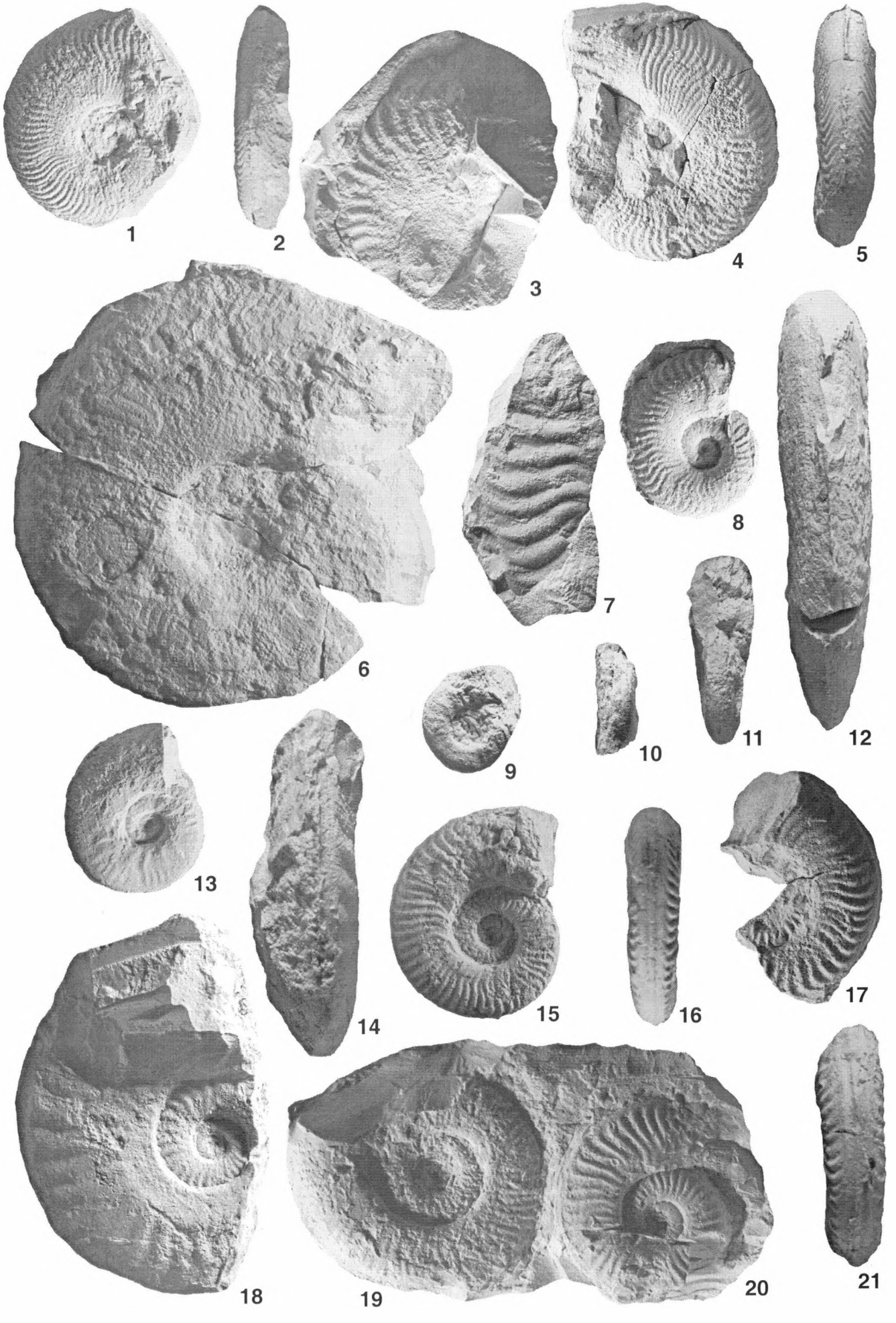
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Plate IV

Figs 1-9: *Fuciniceras ambiguum* (FUCINI)
F. lavinianum Zone, 1, 2: 374BCF1.16, 3-5: 381F1.22, 6, 7: 373BCF0.91, 8, 9: 387BCF1.19.

Figs 10-16, 18: *Fuciniceras lavinianum* (MENEGHINI *in* FUCINI)
F. lavinianum Zone, 10, 11: 264BCF2.02, 12, 18: 234BCF1.83, 13, 14: 254BCF1.32, 15, 16: 229BCF1.33.

Fig. 17: *Fuciniceras isseli* (FUCINI)
F. lavinianum Zone, 288BCF2.18.

Figs 19-22: *Fuciniceras* ? sp. 1
F. lavinianum Zone, 19, 20: 22BCF1.15, 21, 22: 21BCF1.06.


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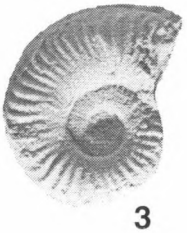
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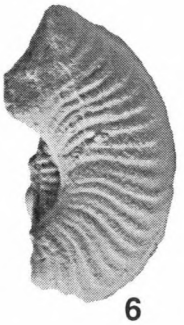
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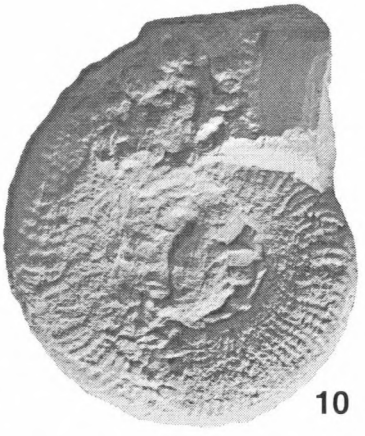
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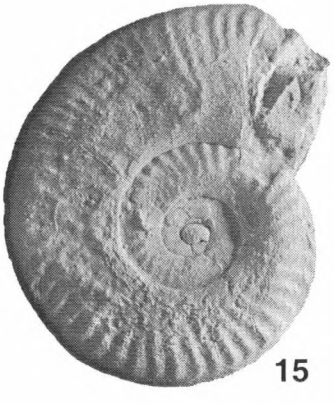
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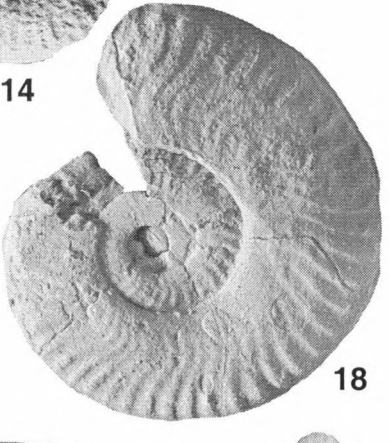
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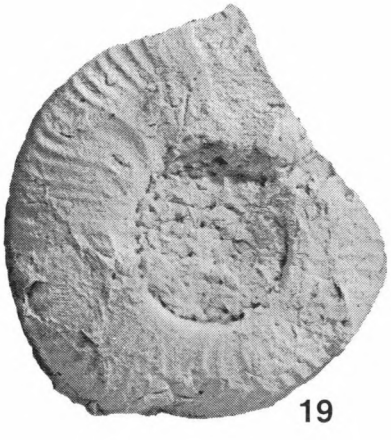
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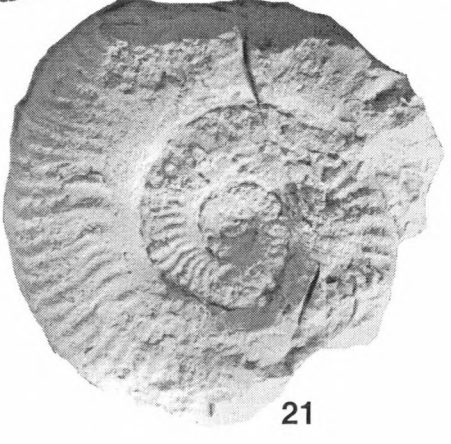
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Plate V

Figs 1, 2: *Fuciniceras isseli* (FUCINI)
F. lavinianum Zone, 285BCF2.12.

Figs 3-6: *Fuciniceras boscense* (REYNES)
F. lavinianum Zone, 3, 4: 226 BCF4.05, 5, 6: 228 BCF3.81.

Figs 7, 8: *Fuciniceras pectinatum* (MENEGHINI)
A. algovianum Zone, 30 BCF6.46.

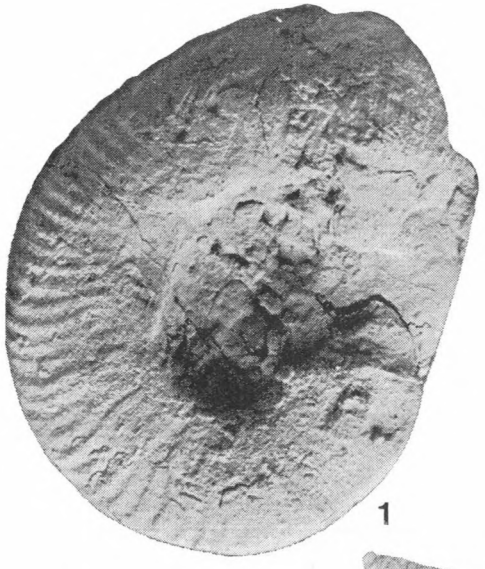
Figs 9, 10: *Fuciniceras* aff. *pectinatum* (MENEGHINI)
A. algovianum Zone, 176BCF7.73.

Figs 11, 12: *Fuciniceras fontaneilleisi* DOMMERGUES & MEISTER
F. lavinianum Zone, 20BCF5.14.

Fig. 13: *Lioceratoides exapatus* (GEMMELLARO)
E. emaciatum Zone, 288BCF14.42.

Figs 14-16, 19, 20: *Lioceratoides naumachensis* (FUCINI)
E. emaciatum Zone, 14, 15: 281BCF15.00, 16: 275BCF15.02, 19: 273BCF15.00, 20: 277BCF14.86.

Figs 17, 18: *Lioceratoides grecoi* (FUCINI) - *loriolii* (BETTONI)
E. emaciatum Zone, 193BCF15.75.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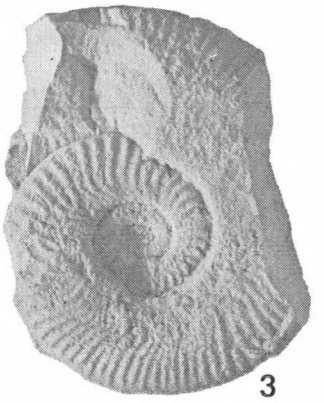
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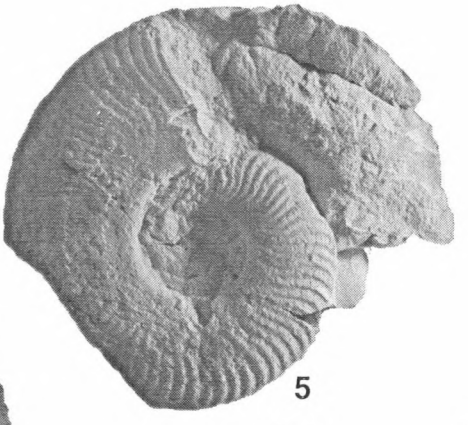
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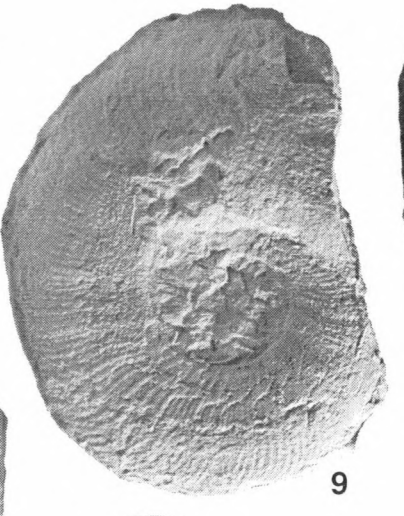
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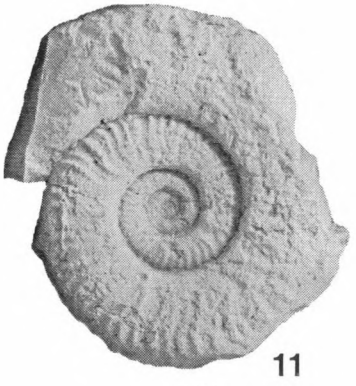
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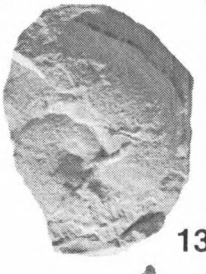
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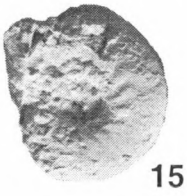
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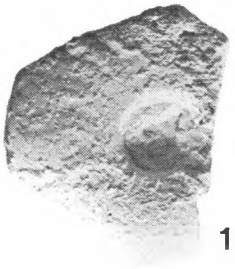
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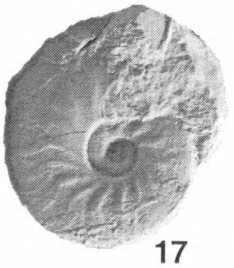
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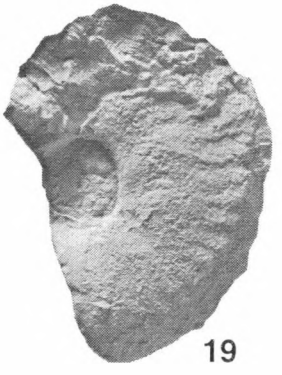
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Plate VI

Figs 1-3, 7, 8: *Lioceratoides grecoi* (FUCINI) - *loriolii* (BETTONI)
E. emaciatum Zone, 1, 2: 198BCF15.67, 3: 187BCF15.62, 7, 8: 200BCF15.75.

Figs 4, 12: *Lioceratoides serotinus* (BETTONI)
E. emaciatum Zone, 210BCF16.88.

Figs 5, 6, 11: *Neolioceratoides expulsus* (FUCINI)
E. emaciatum Zone, 5, 6: 454BCF15.76, 11: 443BCF16.86.

Figs 9, 10: *Neolioceratoides schopeni* (GEMMELLARO)
E. emaciatum Zone, 455BCF17.35.

Figs 13-16: *Neolioceratoides hoffmanni* f. *sordidum* (FUCINI)
E. emaciatum Zone, 13, 14: 438BCF17.18, 15, 16: 434BCF17.30.

Figs 17, 18, 21, 22: *Neolioceratoides hoffmanni* (GEMMELLARO)
E. emaciatum Zone, 17, 18: 437BCF17.49
D. polymorphum Zone, 21, 22: 431BCF17.00.

Figs 19, 20: *Neolioceratoides dinae* (FUCINI)
E. emaciatum Zone, 427BCF16.20.

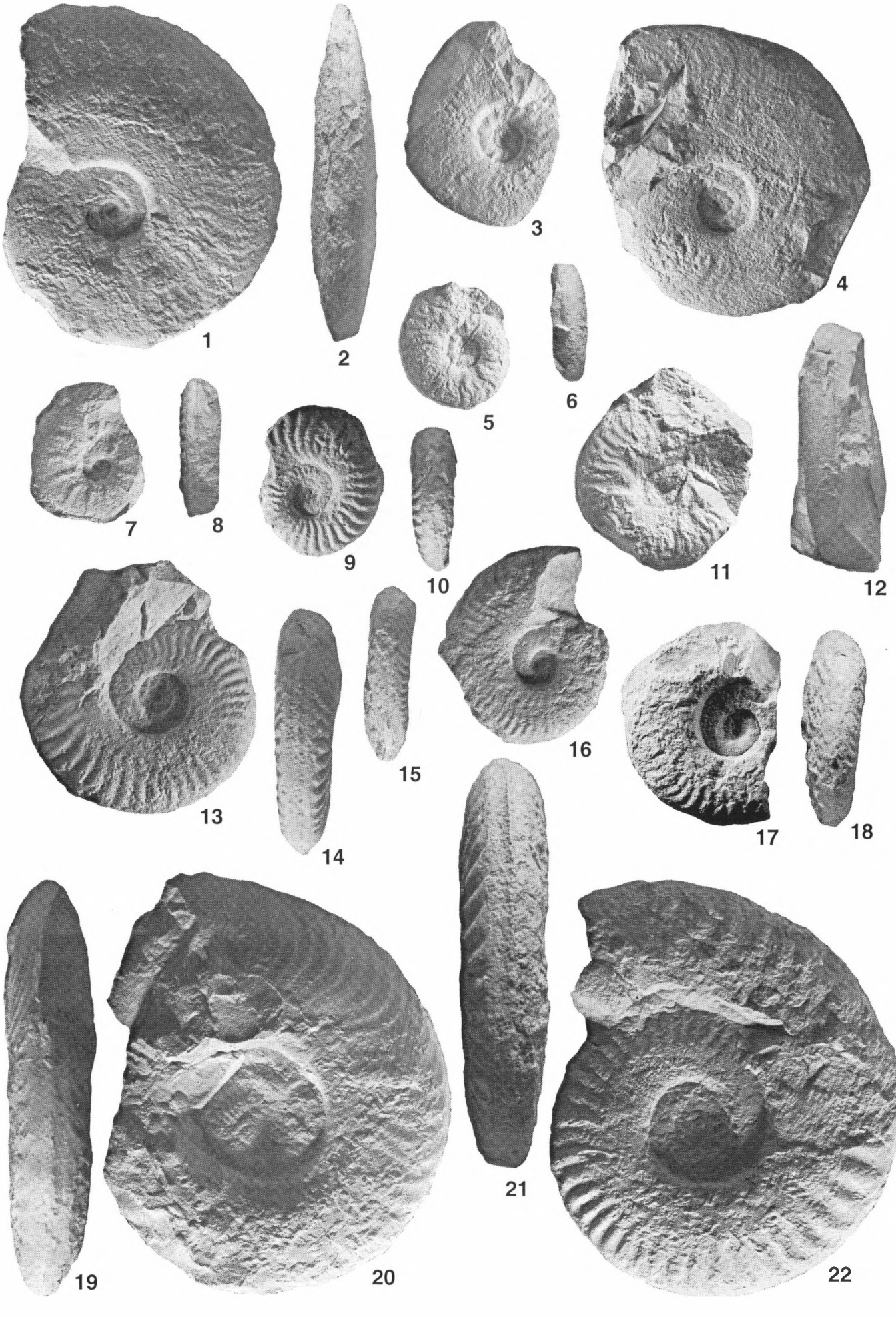
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Plate VII

Figs 1, 3: *Arieticeras* cf. *apertum* MONESTIER
F. lavinianum Zone, 1: 459BCF3.95, 3: 460BCF4.04.

Figs 2, 6-8,10, 11: *Arieticeras amalthei* (OPPEL)
A. algovianum Zone, 2: 74BCF8.43, 6, 7: 72BCF8.20, 8, 11: 76BCF8.49, 10: 75BCF7.03.

Figs 4, 5: *Neolioceratoides infidum* (FUCINI)
E. emaciatum Zone, 425BCF16.89.

Figs 9, 13, 14, 17-19: *Arieticeras bertrandi* (KILIAN)
A. algovianum Zone, 9: 56BCF8.51, 13, 14: 64BCF8.31, 17, 18: 61BCF8.35, 19: 53BCF8.99.

Figs 12, 15, 16: *Arieticeras bertrandi* f. *caterinae* (PARISCH & VIALE)
A. algovianum Zone, 12: 23BCF8.46, 15, 16: 24BCF8.43.

Figs 20, 21, 25: *Arieticeras algovianum* f. *almoetianum* (FUCINI)
A. algovianum Zone, 20, 21: 100BCF9.66, 25: 06BCF9.76.

Figs 22-24: *Arieticeras algovianum* (OPPEL)
A. algovianum Zone, 22, 23: 35BCF9.31, 24: 43BCF9.12.

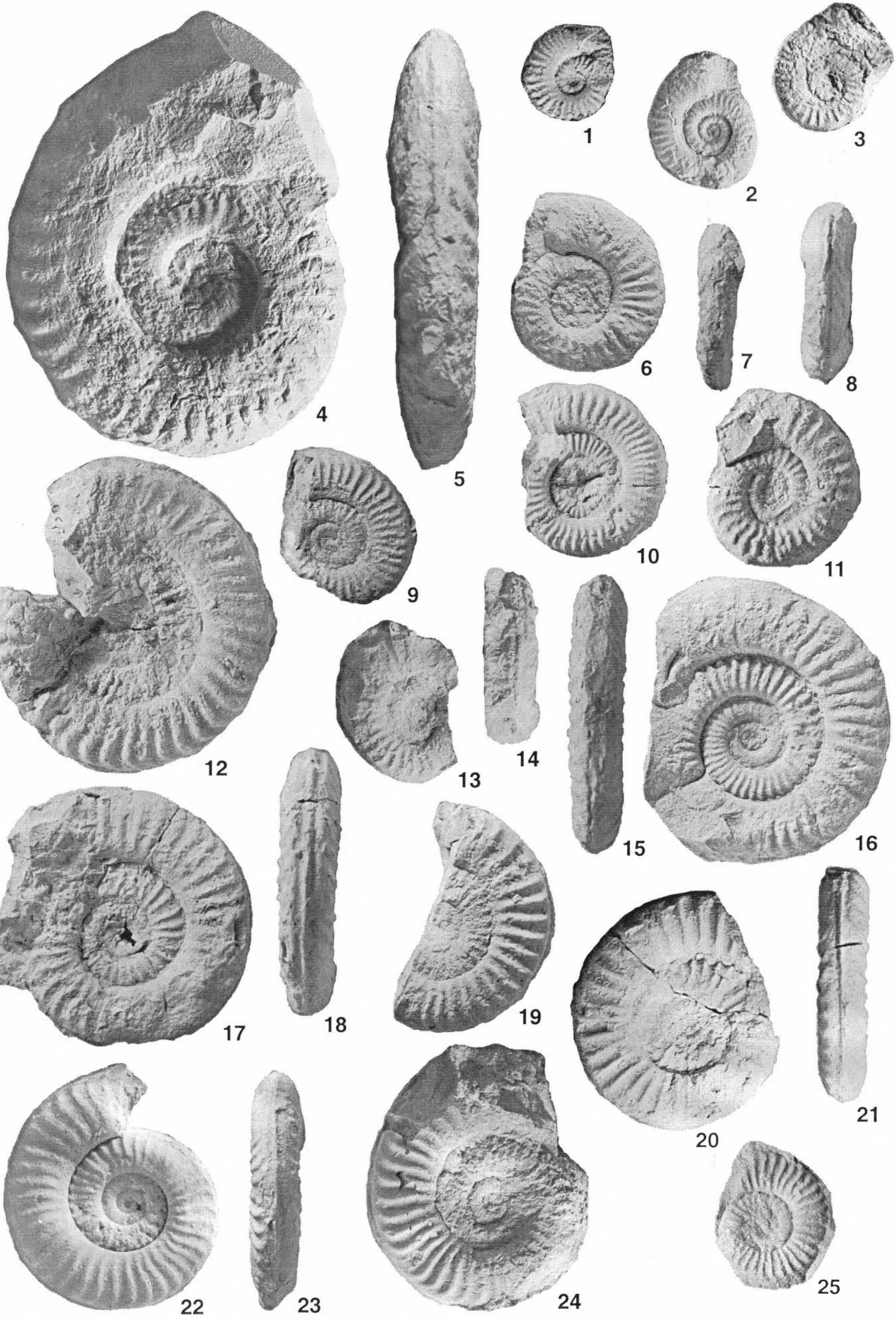
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Plate VIII

Figs 1-4: *Arieticeras algovianum* f. *retrorsicosta* (OPPEL)
A. algovianum Zone, 1, 2: 47BCF9.60, 3: 45BCF9.67, 4: 44BCF9.69.

Figs 5-8: *Arieticeras algovianum* (OPPEL)
A. algovianum Zone, 5, 6: 32BCF9.41, 7, 8: 82BCF9.34.

Figs 9-12: *Leptaleoceras pseudoradians* (REYNES) *sensu* MONESTIER
A. algovianum Zone, 9, 10: 115BCF8.66, 11, 12: 117BCF8.68.

Figs 13-17: *Leptaleoceras ugdulenai* f. *insigne* (FUCINI)
A. algovianum Zone, 13, 16: 149BCF9.08, 14, 15: 145BCF9.09, 17: 143BCF9.08.

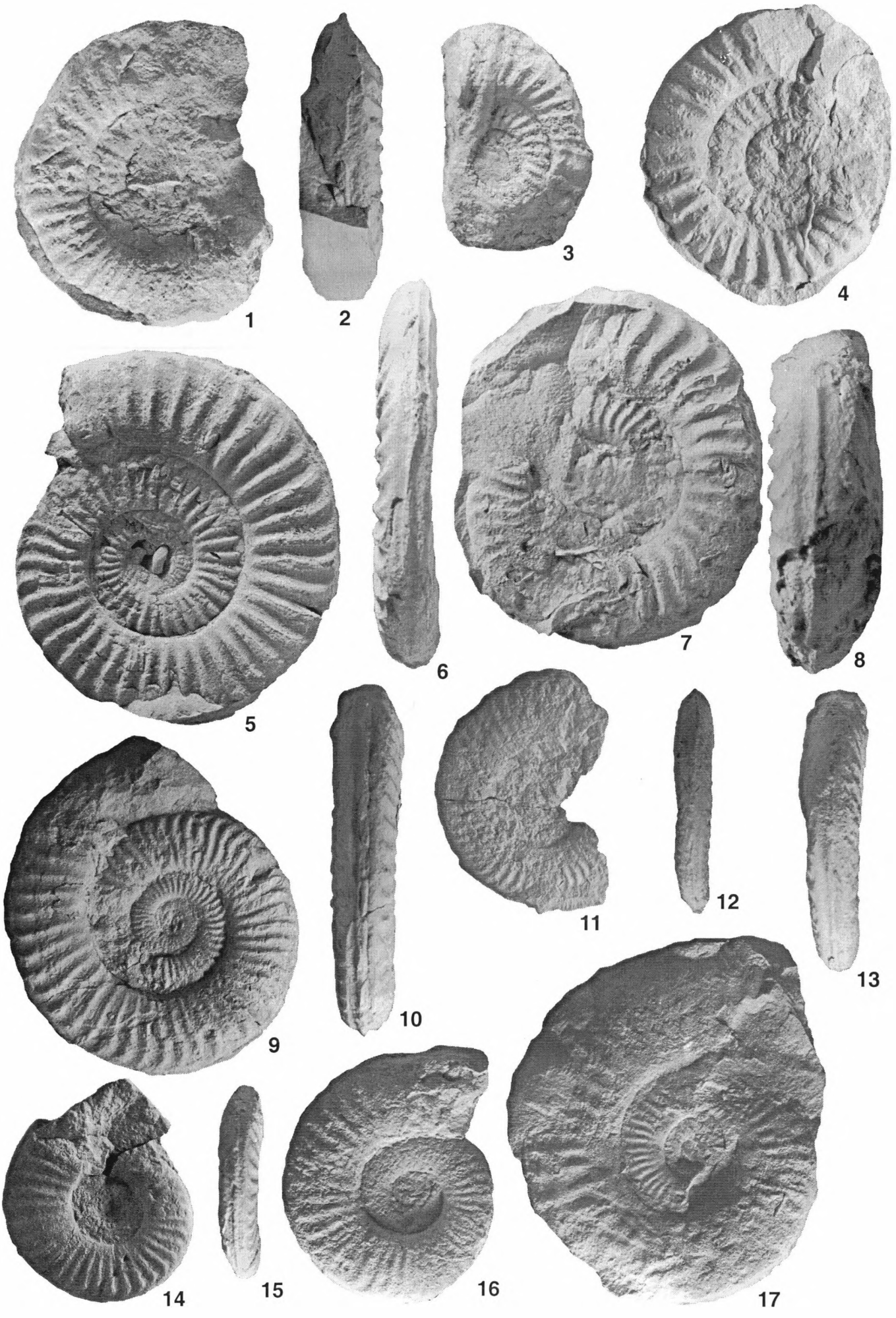
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Plate IX

Figs 1-9, 12:	*Leptaleoceras ugdulenai* (GEMMELLARO) *A. algovianum* Zone, 1, 2: 126BCF9.05, 3, 4: 129BCF9.05, 5, 7: 128BCF9.06, 6, 12: 134BCF9.05, 8, 9: 131BCF9.08.
Figs 10, 11, 13-15, 20, 21:	*Leptaleoceras accuratum* (FUCINI) *A. algovianum* Zone, 10, 11: 108BCF9.31, 13, 14: 109BCF9.33, 15: 111BCF9.33, 20, 21: 110BCF9.33.
Figs 16, 17, 19, 22, 25, 26:	*Leptaleoceras accuratum* f. *preaccuratum* BRAGA *A. algovianum* Zone, 16, 17: 156BCF9.12, 19: 157BCF9.13, 22: 161BCF9.12, 25, 26: 150BCF9.10.
Fig. 18:	*Leptaleoceras* sp. juv. cf. sp. 1 *sensu* BRAGA *A. algovianum* Zone, 1 550BCF9.10.
Figs 23, 24:	*Leptaleoceras*? sp. 1 *A. algovianum* Zone, 1 84BCF9.61.

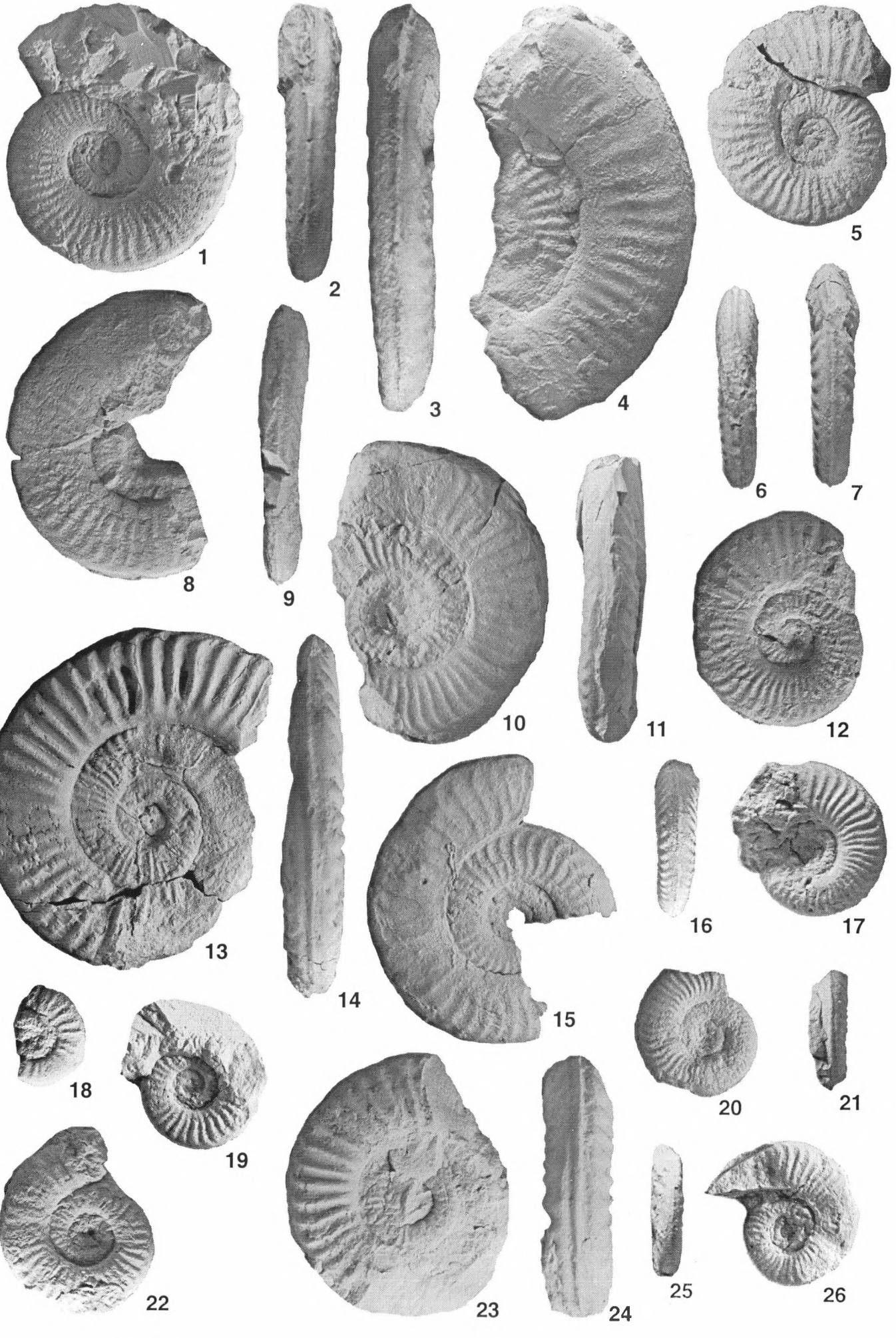
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Plate X

Figs 1, 4: *Fontanelliceras fontanellense* (GEMMELLARO)
E. emaciatum Zone, 1: 179BCF17.18, 4: 178BCF17.08.

Fig. 2: *Emaciaticeras imitator* FUCINI
E. emaciatum Zone, 207BCF16.10.

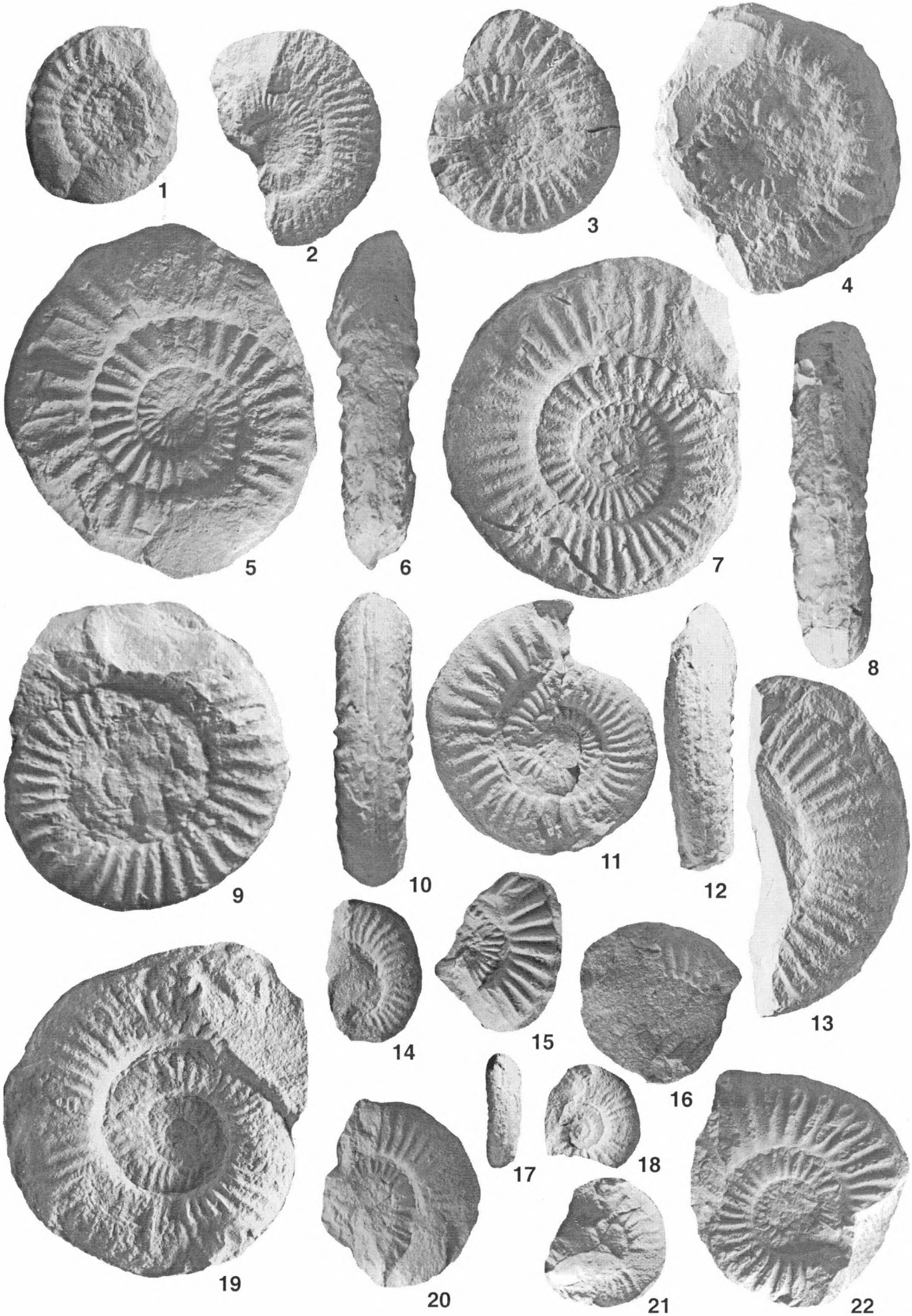
Figs 3, 5-10, 15: *Emaciaticeras emaciatum* (CATULLO)
E. emaciatum Zone, 3: 423BCF16.08, 5, 6: 414BCF16.15, 7, 8: 417BCF16.10, 9, 10: 418BCF16.10, 15: 413BCF16.13.

Figs 11-14, 19, 20: *Emaciaticeras archimedis* FUCINI
E. emaciatum Zone, 11, 12. 404BCF16.70, 13: 400BCF16.37, 14: 202BCF17.19, 19: 403BCF16.57, 20: 182BCF16.63.

Figs 16: *Canavaria zancleana* (FUCINI)
E. emaciatum Zone, 229BCF17.05.

Figs 17, 18, 21: *Emaciaticeras timaei* (GEMMELLARO)
E. emaciatum Zone, 17, 18: 411BCF16.60, 21: 407BCF16.67.

Figs 22: *Emaciaticeras retroplicatum* FUCINI
E. emaciatum Zone, 181BCF16.67.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