Bollettino della Società Paleontologica Italiana	39 (1), 2000	ISSN 0375-7633	29-45	2 pls.	Modena, Febbraio 2000

Early Aptian ammonites from the top of the Maiolica and the anoxic "Selli level" (Lombardy, Southern Alps)

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KEY WORDS – Ammonoidea, Systematics, Biostratigraphy, Palaeoecology, Cretaceous, Aptian, Northern Italy.

ABSTRACT – The paper deals with the description of Early Cretaceous ammonite faunas from black shale layers intercalated within the transition between the Maiolica limestones and the marls of the Marne di Bruntino Formation in a quarry near Cesana Brianza (Como province, Northern Italy). For the first time in Italy ammonites have been collected also in the regional equivalent of the "Livello Selli", corresponding to the oceanic anoxic event OAE 1a. The ammonites studied have been assigned to the Early Aptian by means of integrated bio- and magnetostratigraphy. In fact, ammonite biostratigraphic markers are scarce in a distal Mediterranean area such as the Lombardy basin because of the evolutionary stasis in the majority of the groups and the rarity of representatives of the family Deshayesitidae; the latter are absent at Cesana Brianza. From a palaeoecological point of view, most of the studied ammonites had apparently a pelagic mode of life and some of them were opportunists (Leptoceratoidinae). In the "Livello Selli" anoxia probably did not reach the upper part of the water column.

RIASSUNTO – [Ammoniti dell'Aptiano inferiore dal Top della Maiolica e dal "livello Selli" (Lombardia, Alpi meridionali)] – *Sono descritte le ammoniti del Cretacico Inferiore presenti in black shales intercalate nell' intervallo transizionale tra la Maiolica e le Marne di Bruntino di una successione esposta nella cava di Cesana Brianza (Como). Ammoniti sono state rinvenute anche nell'equivalente regionale del "Livello Selli", che corrisponde all'evento anossico oceanico OAE 1a. In mancanza di marker biostratigrafici, che in un'area mediterranea distale come il bacino Lombardo sono scarsi a causa della stasi evolutiva nella maggioranza dei gruppi di ammoniti presenti e della rarità di rappresentanti della famiglia Deshayesitidae, assente a Cesana Brianza, le faune raccolte sono state attribuite all'Aptiano inferiore in base alle scale bio- e magnetostratigrafiche integrate. Dal punto di vista paleoecologico le associazioni ad ammoniti sono prevalentemente caratterizzate da forme adattate ad ambienti pelagici con modo di vita svincolato dai fondi marini e da forme opportuniste (Leptoceratoidinae). L'associazione indicherebbe che durante la deposizione del "Livello Selli" l'anossia non doveva raggiungere la parte superiore della colonna d'acqua.*

INTRODUCTION

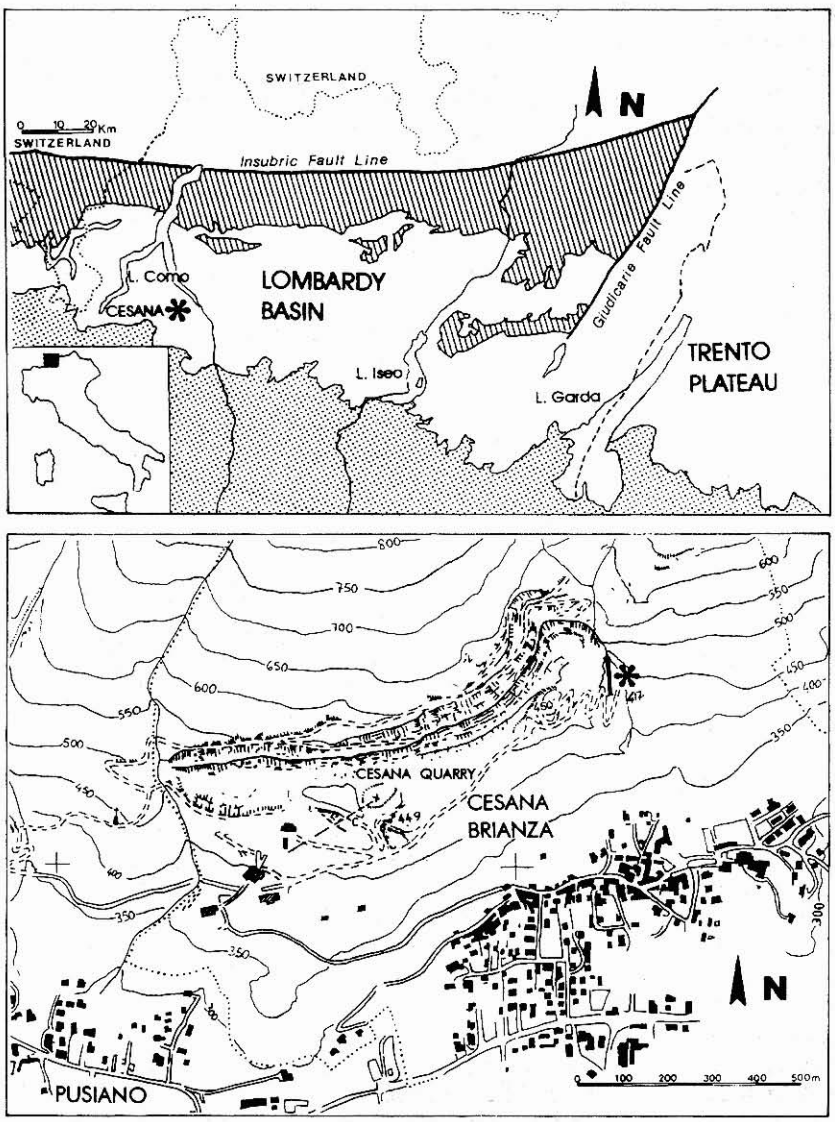
The Lower Cretaceous pelagic successions widespread in both Northern and Central Italy are remarkably poor in ammonites, a fact that prevented a comprehensive calibration of both the detailed biostratigraphy based on calcareous and siliceous plankton and magnetostratigraphy to ammonite zones and stage boundaries. Only recently, some ammonites were found in few sections from the Umbria-Marche basin (central Italy) within the Maiolica Formation, which allowed us to place some firm ties such as the Hauterivian/Barremian boundary falling in magnetic chron CM4 (Cecca *et al.*, 1994a). Some ammonites were also collected (Cecca & Landra, 1994) from two sections exposed in the quarries of Cesana Brianza, north of Milan (Southern Alps, Northern Italy). The ammonites indicate a late Barremian and possibly an earliest Aptian age, while few ammonites of early Aptian age were recorded in a third nearby section (= Section C of Cecca & Landra, 1994).

The Cesana Brianza sections span the transition between the Maiolica and Marne di Bruntino formations, which is characterized by the presence of an organic-rick black layer, identified as equivalent of the anoxic "Livello Selli" (= LSE) of the Umbria-Marche region (Bersezio, 1994). In particular, some ammonites were also collected from within the LSE, the first Italian ammonite record in this layer.

The aim of this paper is to describe the ammonite faunas recently collected in successive layers, along with the previous findings, from Section C of Cecca & Landra (1994), despite the poor preservation of the specimens and the impoverished character of the assemblages.

THE "LIVELLO SELLI" AND ITS EQUIVALENTS: GEOGRAPHIC DISTRIBUTION AND AGE.

A prominent black horizon was identified at the transition between the Maiolica and "Marne a Fucoidi" pelagic formations in the Umbria-Marche area (Central Italy) by Wezel (1985) and formalized with the name "Livello Selli" by Coccioni *et al.* (1987) as a regional marker-level. In the type area the "Livello Selli" consists of laminated black shales rich in organic matter, alternated with radiolarian silts. Its thickness ranges from 1 to 3 m and its carbonate content is close to 0%. The "Selli Level" has been recognized in other areas such as the Belluno Basin (northeastern Italy) in the Cismon section (Weissert,1989; Herbert, 1992; Erba & Larson, 1998), the Lombardy



Text-fig. 1 - Location map of the study area and regional geological setting (above). Dotted: Quaternary sediments of the Po Plain; ruled: predominantly igneous and metamorphic rocks; plain (in the middle part of the sketch): Permian and Mesozoic sediments; dashed line: approximate limit of Mesozoic palaeogeographic zones (Trento Plateau and Lombardy Basin). Below, topographic map showing the location of the quarry; the asterisk indicates the studied section.

basin at Cesana (Bersezio, 1994), and the Vocontian Basin (southern France), where it was named "Niveau Goguel" (Bréhéret, 1988).

The "Livello Selli", with similar lithological features (Corg- and radiolarian-rich laminated horizon) occurs in the same stratigraphic position also in the Pacific Ocean (Sliter, 1989) where it was recovered in the DSDP (Deep Sea Drilling Project) Sites 463 (Mid Pacific Mountain), 167 (Magellan Rise), 305 (Shatsky Rise), and 317 (Manihiki Plateau). Organic-rich layers, also called "black shales", are peculiar of the oceanic domain in mid-Cretaceous "green house" time; they occur as discrete layers and record the Oceanic Anoxic Events (OAEs), the oldest of which was indicated as OAE1a by Arthur *et al.* (1990) and coincides with the Selli Level. Bralower *et al.* (1994) demonstrated that OAE1a is present also in Northern Atlantic (DSDP Sites 402 – Bay of Biscay, 417 – Bermuda basin, and Ocean Drilling Program Site 641 – Galicia Bank), in Southern Atlantic (DSDP Sites 364 – Angola basin and 511 – Falkland Plateau), and in Indian Ocean (ODP Site 738 – Exmouth Plateau).

Although most of the localities mentioned above belong to the Tethyan and oceanic tropical domains, in analogy with the Austral ocean an equivalent of this event seems to be present in the Boreal realm. Jenkyns (1980) reported some discontinuous bituminous shales from the Lower Aptian of the North Sea (data from Anderton *et al.*, 1979) and the Lower Aptian "Fischschiefer" from the Lower Saxony epeiric sea (Germany) was suggested to be coeval and equivalent of the OAE1a (Thurow & Mutterlose, 1993; Bersezio, 1994). The latter correlation, however, is disputed by Kemper (1995), who on the basis of the data from Wiechendorf 1/86 borehole, suggested

a brief heterochrony between the "Fischschiefer" and the "Livello Selli", the latter having its time-equivalent in a higher horizon of the same borehole.

The correlation between OAE1a and the "Livello Selli" is supported by bio- and magneto-stratigraphic data. The "Livello Selli" from the Gorgo a Cerbara section (Umbria-Marche basin) (Lowrie *et al.*, 1980; Lowrie & Alvarez, 1984; Channell *et al.*, 1995), or the "Selli equivalent" from the Cismon section and APTICORE (Belluno Basin, Venetian Southern Alps) (Channell *et al.*, 1995; Erba & Larson, 1998), and in the Cesana Brianza section (Lombardy Basin)) (Channell *et al.*, 1995) as well as OAE1a equivalents from the Pacific DSDP Sites 167 and 463 (Sliter, 1989), all fall in the lower part of the Long Cretaceous Normal.

In terms of calcareous nannofossil biostratigraphy, all the "Livello Selli" and Selli equivalents from all the localities mentioned above, then including the Pacific, Atlantic and Indian oceans, fall in the upper part of the *Chiastozygus litterarius* Zone, whose base is better identified by the first appearance (FO) of *Rucinolithus irregularis*, and just prior to the FO of *Eprolithus floralis* (see Erba, 1996 for a synthesis) (Text-fig. 2).

Concerning planktonic foraminiferal biostratigraphy, the OAE1a and the Selli Levels at the same localities were attributed to the upper part of the *Globigerinelloides blowi* Zone (Coccioni *et al.*, 1987; Coccioni *et al.*, 1992; Bréhéret & Delamette, 1989; Sliter, 1989; Bralower *et al.*, 1994; Weiss, 1995), just below the FO of *Leopoldina cabri*, which defines the base of the *Leopoldina cabri* Zone (Caron, 1985). Recent study on the Cismon APTICORE (Premoli Silva *et al.*, 1998; Erba *et al.*, in press), however, proved that the Selli Level is entirely comprised in the *Leopoldina cabri* Zone, as this taxon appears just below the Selli in agreement with an earlier appearance of *Leopoldina cabri* within the early Aptian *D. weissi* Zone in French Vocontian Basin (Magniez-Jannin *et al.*, 1997). It is worth mentioning that *L. cabri* is rare at the beginning of its range and frequently subjected to dissolution along with other planktonic foraminifera; that justifies why Moullade *et al.* (1998) reported the FO of *L. cabri* only from the top part of the *D. deshayesi* Zone in La Bédoule section (SE France).

Direct correlation between calcareous nannofossil events and ammonite zonation indicates that the FO of *R. irregularis*, equated to the base of the *Chiastozygus litterarius* Zone, falls within the latest Barremian *Martelites sarasini* ammonite Zone (Cecca *et al.*, 1994b; Erba, 1996; Aguado *et al.*, 1997), and occurs well below the base of the anoxic event at Cesana Brianza (Erba *in* Bersezio, 1994; Channell *et al.*, 1995), Gorgo a Cerbara (Coccioni *et al.*, 1992), and Wiechendorf 1/86 borehole (Cepek, 1995). On the other hand, the FO of *Eprolithus floralis* is recorded above the top of the LSE in the Cesana Brianza section (Erba *in* Bersezio, 1994), above the top of the "Fischschiefer" in Wiechendorf 1/86 borehole (Cepek, 1995), and at the base of the *Dufrenoyia furcata* Zone (= *Tropaeum bowerbanki/Dufrenoyia* spp. in Moullade *et al.*, 1998) from La Bédoule (SE France).

According to Mutterlose (1992) and Keupp & Mutterlose (1994), the "Fischschiefer" spans the interval from the upper part of the *Deshayesites forbesi* Zone to the lower part of the *Deshayesites deshayesi* Zone and it is sandwiched by the FOs of the calcareous nannofossil *Flabellites oblongus* and *Rhagodiscus angustus* below and *Eprolithus varolii* and *E. floralis* above. The FO of *R. angustus* is recorded at the boundary between the *D. weissi* and *D. deshayesi* Zones at La Bédoule (Moullade *et al.*, 1988).

All the data point to a late Early Aptian age for the "Livello Selli" and all the events related to OAE1a. (Text-fig. 2)

DESCRIPTION OF THE STUDIED SECTION

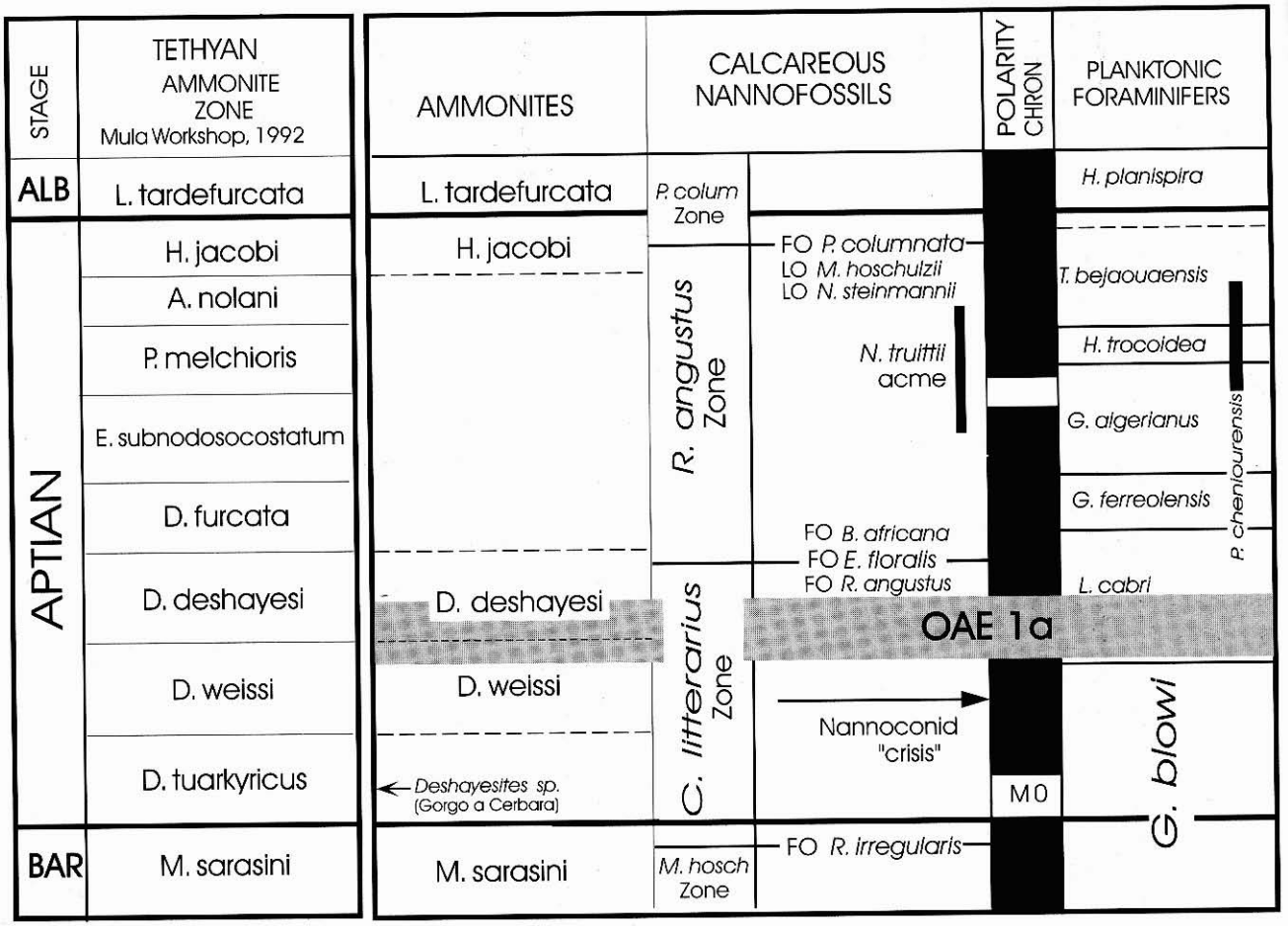
The ammonites were collected from Section C of Cecca & Landra (1994), located in the eastern part of the Cesana Brianza quarry (Text-fig. 1), that corresponds to the succession studied by Bersezio (1993, 1994) and to the section named "Alpetto" by Channell *et al.* (1995).

The fossils here described come from a succession of black-shale beds intercalated between the top of the Maiolica and the base of the Marne di Bruntino formations (Text-fig. 3). More precisely, the ammonite beds belong to the "transitional facies" recognized by Barberis *et al.* (1992) and subsequently studied in detail by Bersezio (1993). The "transitional facies" is characterized by a rhythmic alternation of limestones and marls whose terrigenous fraction increases upwards.

According to Bersezio (1994) the LSE falls between the "transitional facies" and the Marne di Bruntino Formation; it yielded some ammonites at m 39-39.5 (Text-fig. 3).

A more detailed lithostratigraphic log than that presented by Cecca & Landra (1994) is reported in Text-fig. 3. The same log was used by Channell *et al.* (1995) during the sampling for the magnetostratigraphic study of their Alpetto section (= our Section C). Bersezio (1994) recognized a "lower critical level" and "upper critical level" (LCL and UCL, respectively) below and above the LSE. These terms were originally introduced by Coccioni *et al.* (1992) to describe two intervals sandwiching the "Livello Selli" and characterized by absent or depleted planktonic foraminifera in the Gorgo a Cerbara section. In Bersezio (1994) they are informally used to indicate a mere lithological similarity with the Gorgo a Cerbara critical levels, that are more calcareous than the LSE, and do not refer to the palaeontological content.

The ammonites described in this paper include also those already cited by Cecca & Landra (1994) above metre 9.68. The up-dated faunal list is report-



Text-fig. 2 - Integrated stratigraphy of the Aptian Stage for Tethys and low latitudes (modified after Erba, 1996).

ed below in stratigraphic order (the numbers in brackets represent the number of specimens):

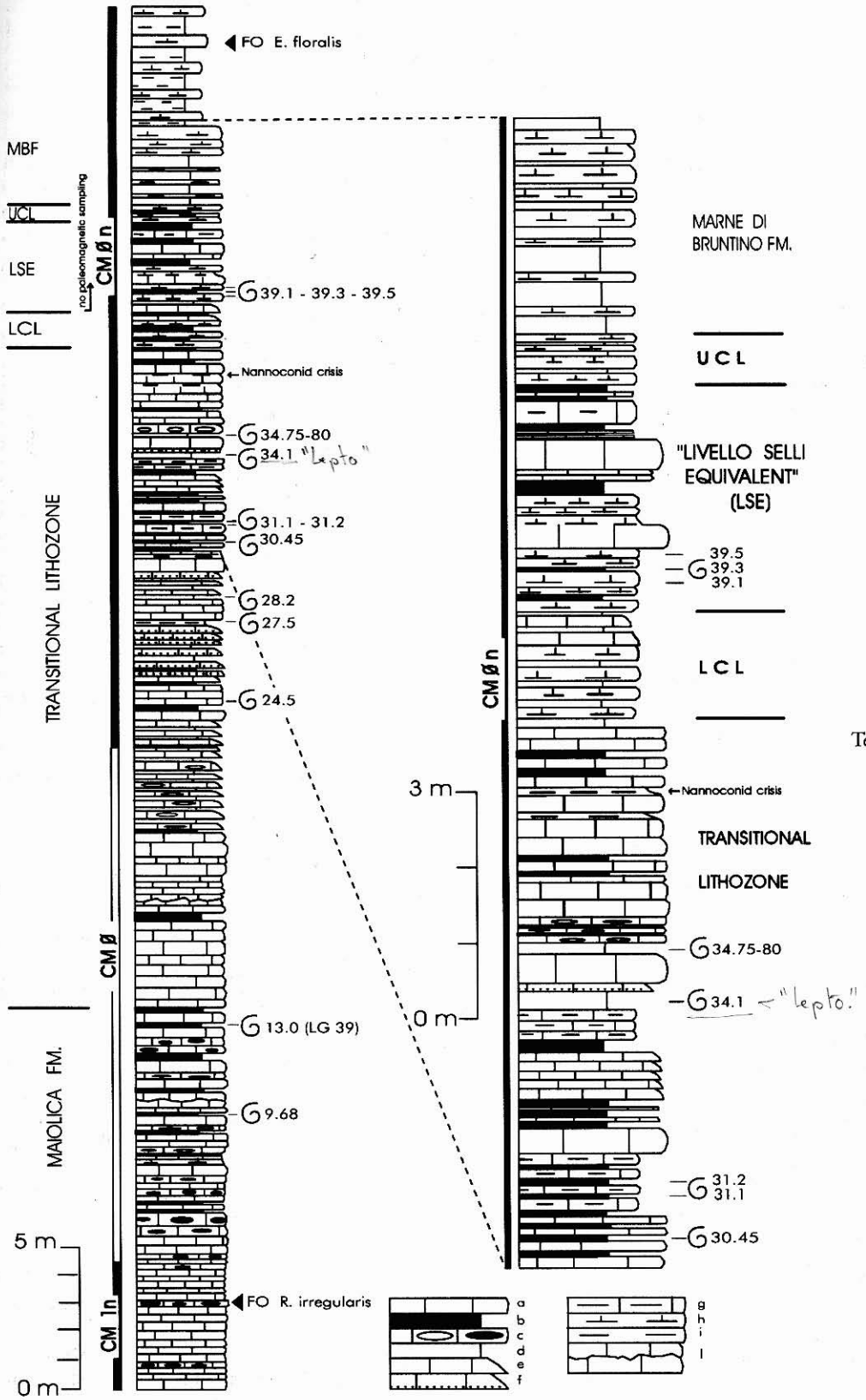
Transitional facies
metre 24.5: *Macroscaphites* (*Costidiscus*) sp. (1), gen. and sp. indet. (3);
metre 27.5: *Phylloceras* sp. (1);
metre 28.2: gen. and sp. indet. (1);
metre 30.45: *Lytoceras* sp. (1);
metre 31.1: *Silesites* sp. (1);
metre 31.2: *Ptychoceras* cf. *meyrati* (1), *Silesites* aff. *seranonis* (2), *Silesites* sp. (2), gen. and sp. indet. (1);
metre 34.1: *Lytoceras* sp. (1), ?*Costidiscus* sp. (1), *Melchiorites* sp. (2), *Silesites* aff. *seranonis* (10), *Silesites* sp. (3), *Ptychoceras poni* (1), *Ptychoceras* sp. form 1 (1), *Procheloniceras* cf. *sporadicum* (1), *Leptoceratoides hoheneggeri* (7), fragments of reptile bones, plant debris;
metre 34.75-34.80: *Macroscaphites* (*Costidiscus*) *recticostatus* (1), Ancyloceratidae gen. et sp. indet. (2).

Livello Selli Equivalent
metre 39.1: *Lytoceras* sp. (4), Desmoceratidae gen. et sp. indet. (1), *Melchiorites* cf. *melchioris* (1);
metre 39.3: *Macroscaphites* (*M.*) sp. (1), *Ptychoceras* sp. form 2 (1);
between metre 39-39.5: *Eulytoceras anisoptychum* (3), *Eulytoceras phestum* (2), *Lytoceras* sp. (5), *Melchiorites* cf. *melchioris* (3), *Melchiorites* sp. (1), *Ptychoceras* cf. *meyrati* (1), ?*Ancyloceras (Audouliceras)* cf. *fallauxi* (1), *Ancyloceras* sp. (1);
metre 39.5: *Lytoceras* sp. (2).

SYSTEMATIC DESCRIPTIONS

We follow the classification of the Cretaceous Ammonoidea by Wright *et al.* (1996). The standard dimensions for normally coiled ammonites are given in millimetres and as percentages of the diameter. The following abbreviations have been used:

D = maximum diameter;
d = diameter at which measurements were taken when less than D;
Uw = umbilical width;
Wh = whorl height;
K = number of ribs per whorl (K/2 per half whorl);
Concerning uncoiled ammonites the terms used in



Text-fig. 3 - Stratigraphic log of Section C, Cesana Brianza. Legend: a) pelagic calcilutites; b) black shales; c) pelagic calcilutites with grey or black cherts; d) grey or green shales; e) turbiditic calcilutites; f) turbiditic calcisiltites; g) marly calcilutites; h) marls; i) shales at the top of the turbiditic layer; l) slump. Abbreviations: LCL = Lower Critical Level; LSE = "Livello Selli" Equivalent; UCL = Upper Critical Level; MBF = Marne di Bruntino Formation. The numbers of the fossiliferous levels correspond to the samples of Channell *et al.* (1995) studied for magnetostratigraphy.

the descriptions and abbreviations of the dimensional characters are:
H = maximum height of the specimen;
Lh = hook lenght;
Ls1, Ls2 = 1st and 2nd shaft lenght;
hb = whorl height at the bend;
hh = whorl height at the hook;
hs = whorl height at the shaft.

The poor preservation of our specimens prevented to obtain measurements of the whorl breadth and, generally, to observe the sutures.

The specimens are housed in the "Museo di Paleontologia" of the University of Milan (MPUM), numbers 8218 to 8271, followed in brackets (ex. 8243 (K 141)) by our own numbers. In fact, a MPUM number may include more than one specimen of the same species, whilst our own numbers indicate the single specimens and are useful to distinguish the different specimens in the measurement tables.

Class CEPHALOPODA Leach, 1817
Order AMMONOIDEA Zittel, 1884
Suborder LYTOCERATINA Hyatt, 1889
Superfamily LYTOCERATACEAE Neumayr, 1875
Family LYTOCERATIDAE Neumayr, 1875
Subfamily LYTOCERATINAE Neumayr, 1875

Genus EULYTOCERAS Spath, 1927

Type species – *Ammonites inaequalicostatus* d'Orbigny, 1840.

EULYTOCERAS PHESTUM (Matheron, 1878)
Pl. 1, fig. 1

1878 *Ammonites phestus* MATHERON, pl. C-20, fig. 5 a-c.
1949 *Lytoceras phaestus* Math. - VIALLI, p. 42, pl. 1, fig. 3.
1972 *Eulytoceras phestum* (Matheron) - VASICEK, p. 37, pl. 2, fig. 6 (*cum syn.*).
1975 *Eulytoceras phestum* (Matheron) - MURPHY, p. 18, pl. 2, fig. 3.
1995 *Eulytoceras phestum* (Matheron) - AVRAM, pl.12, figs. 1-3 b.
1997 *Eulytoceras phestus* (Matheron) - DELANOY, pl. 3, fig. 5.

Material – Two specimens: the internal mould of a juvenile shell and its impression 8242 (K 140) and a fragment 8243 (K 141).

Dimensions (in mm) –

specimen	D	Uw	Wh	K/2
8243 (K 141)	14	5.5 (0.39)	5.5 (0.39)	22

Description – Evolute shell with fine uniform and broadly spaced ribbing. Ribs simple, continuous, sharp but fine; close to the periumbilical margin they tend to gently bend backwards. The interspace between two ribs is wide as six ribs in specimen 8243 (K 141) and three ribs in the juvenile form 8242 (K 140).

Discussion – The bending of the ribs is less pronounced than in the specimen figured as *E. phestum* by Kilian & Reboul (1915, pl. 1, fig. 2). According to Vasicek (1972), in *E. phestum* the number of ribs per whorl is mainly 40, but it may occasionally vary from 32 to 44. As described by Murphy (1975) the ribs are closely spaced in the late growth stage. In our specimens counting of the ribs on a whole whorl was prevented and only in specimen 8242 (K140) it is possible to observe 22 ribs in the last half whorl. *E. phestum* differs from *E. raricinctum* in having a closer ribs spacing. Both specimens are internal molds and evidence of flares is lacking.

Stratigraphic level – Both specimens come from metre 39.

EULYTOCERAS ANISOPTYCHUM (Uhlig, 1883)

1883 *Lytoceras anisoptychum* UHLIG, p. 190, pl. 4, fig. 7; pl. 14, fig. 9.
1883 *Lytoceras* n. f.? aff. *anisoptychum* UHLIG, p. 190, pl. 4, fig. 8.
1972 *Eulytoceras anisoptychum* (Uhlig) - VASICEK, p. 39, pl. 2, fig. 7 (*cum syn.*).
1994a *Eulytoceras anisoptychum* (Uhlig) - CECCA *et al.*, fig. 5f.
1995 *Eulytoceras anisoptychum* (Uhlig) - AVRAM, pl. 11, fig. 12.
1998 *Eulytoceras anisoptychum* (Uhlig) - CECCA *et al.*, p. 68, pl. 1, figs. 17, 18.

Material – Three specimens: two internal moulds 8261 (K 168), 8261 (K 169) and a fragment with its impression 8261 (K 170 a, b).

Dimensions (in mm) –

specimen	D	Uw	Wh
8261 (K 168)	26	10.5 (0.40)	11 (0.41)
8261 (K 169)	13	5.5 (0.42)	4.5 (0.35)

Description – The shell is evolute and the sculpture is formed by weak ribs. The main feature of this species is the alternance of two type of ribs. Two to three weak ribs are present between two slightly thicker ribs, referred by Vasicek (1972) to flares' bases. This feature was observed only in specimen 8261 (K 170a) and doubtfully in specimen 8261 (K 168).

Discussion – According to Uhlig (1883, p. 190) the typical alternance of strong and weak ribs begins after the diameter of 15 mm. Our specimens are smaller than those figured by Uhlig (1883) and Vasicek (1972) and therefore they do not show the characters of the adults.

Stratigraphic level – All specimens from metre 39.

Suborder AMMONITINA Hyatt, 1889
Superfamily DESMOCERATACEAE Zittel, 1895
Family DESMOCERATIDAE Zittel, 1895
Subfamily PUZOSIINAE Spath, 1922

Genus MELCHIORITES Spath, 1923

Type species – Ammonites melchioris Tietze, 1872.

MELCHIORITES cf. MELCHIORIS (Tietze, 1872)
Pl. 1, figs. 4, 5

Material – Four specimens: 8254 (K 162), 8257 (K 167), 8257 (K 172), 8260 (K 171).

Dimensions (in mm) –

specimen	D	Uw	Wh
8254 (K 162)	27	7.5 (0.28)	12 (0.44)
8257 (K 167)	29	~ 8 (0.28)	12 (0.41)
8257 (K 172)	19.5	5 (0.26)	8.5 (0.44)

Description – Moderately evolute shells with slightly prorsiradiate constrictions. These begin straight but above the upper third of the flank they become projected forward.

Discussion – The specimens studied are compared to *M. melchioris* (Tietze) (whose type-specimens and further topotypes have been figured by Avram, 1978) on the basis of the shell coiling, the number and the shape of the constrictions. However, their preservation does not allow us a more precise determination.

Stratigraphic level – Specimens 8257 (K 172), 8257 (K 167), 8260 (K 171) from metre 39; specimen 8254 (K 162) from metre 39.1.

MELCHIORITES sp.

Material – Two specimens, 8250 (K 156), 8250 (K 163).

Dimensions (in mm) –

specimen	D	Uw	Wh
8250 (K 156)	34	8.5 (0.25)	15.5 (0.46)

Discussion – Fragments of possible *Melchiorites* without any preserved character preventing identification at species level.

Stratigraphic level – Both specimens from metre 34.1.

Family SILESITIDAE Hyatt, 1900
Genus SILESITES Uhlig, 1883

Type species – Ammonites seranonis d' Orbigny, 1841.

SILESITES aff. S. SERANONIS (d' Orbigny, 1841)
Pl. 1, figs. 6-10

pars 1883 *Ammonites trajani* Tietze - UHLIG, p. 234, pl. 18, fig. 4 only.
1960 *Silesites seranonis* Orbigny - DRUSCHITS, pl. 45, figs. 6-8.
1995 *Silesites* aff. *seranonis* (d'Orbigny) - AVRAM, pl. 17, figs. 7-9.

Material – Thirteen specimens, 8218 (K 100), 8218 (K 108), 8218 (K 110), 8218 (K 111), 8218 (K 112), 8219 (K 101), 8220 (K 102), 8221 (K 103), 8227 (K 113), 8228 (K 114), 8238 (K 135), 8239 (K 137), 8251 (K 157).

Dimensions (in mm) –

specimen	D	Uw	Wh	K
8218 (K 100)	21	7.5 (0.36)	7.5 (0.36)	-
8219 (K 101)	~24.5	10.5 (0.43)	8.25 (0.34)	33
8220 (K 102)	~23	-	-	-
	~19	7 (0.36)	7 (0.36)	35
8221 (K 103)	18.5	7 (0.37)	6 (0.32)	-
8218 (K 110)	~15	5.5 (0.36)	5.5 (0.36)	-
8218 (K 112)	~17	7.5 (0.44)	5.5 (0.32)	-
8227 (K 113)	9.5	4 (0.42)	3 (0.315)	-
8238 (K 135)	10	4 (0.40)	3.25 (0.325)	-
8239 (K 137)	46	17.5 (0.38)	16 (0.35)	-

Description – Evolute shell with numerous fine, prorsiradiate ribs which are strongly projected on venter. There are generally 3-4 simple ribs per one biplicate rib. The latter branch at the upper third of the flank. Constrictions are wider than the interspace between two ribs: 7 constrictions were observed in specimen 8220 (K 102) at D ~ 23.

Discussion – The specimens described are similar to *S. seranonis* but the smaller umbilicus, the finer ribbing and the more numerous constrictions in the majority of the individuals suggest the temporary distinction of our forms from *S. seranonis s. str.* The same conclusion has been reached by Avram (1995). Further research will clarify the taxonomic status of this group. Two hypotheses can be made: 1) gradual evolution of the species *S. seranonis* with progressive increase within the population of individuals with narrower umbilicus and more numerous constrictions; 2) actual speciation. In the latter case the specimens described above should be included in a new species.

Stratigraphic level – 8238 (K 135), 8239 (K 137) from metre 31.2; 8218 (K 100), 8218 (K 108), 8218 (K 110), 8218 (K 111), 8218 (K 112), 8219 (K 101), 8220 (K 102), 8221 (K 103), 8227 (K 113), 8228 (K 114) from metre 34.1; 8251 (K 157) from rubble.

SILESITES sp.

Material – Six specimens: 8225 (K 109), 8225 (K 115), 8226 (K 116), 8245 (K 147), 8245 (K 158), 8262 (K 174).

Dimensions (in mm) –

specimen	D	Uw	Wh
8226 (K 116)	13.5	5.5 (0.41)	4.5 (0.33)

Discussion – The incomplete preservation of these specimens prevents the specific identification, although they seem to be close to *Silesites* aff. *S. seranonis.*

Stratigraphic level – 8262 (K 174) from metre 31.1; 8245 (K 147), 8245 (K 158) from metre 31.2; 8225 (K 109), 8225 (K 115), 8226 (K 116) from metre 34.1.

Suborder ANCYLOCERATINA Wiedmann, 1966
Superfamily ANCYLOCERATACEAE Gill, 1871
Family ANCYLOCERATIDAE Gill, 1871
Subfamily ANCYLOCERATINAE Gill, 1871

Genus ANCYLOCERAS d'Orbigny, 1842

Type species – *Ancyloceras matheronianum* d'Orbigny, 1842.

? ANCYLOCERAS sp.
Pl. 1, fig. 11

Material – 8241 (K 139), a fragment crushed laterally and coated with oxides.

Description – Fragment of the initial, uncoiled, part of the shell and the beginning of the shaft. The whorl height rapidly increases with the growth. The sculpture is made of fine, simple, regularly spaced, secondary ribs intercalated with tubercle-bearing primary ribs. Four secondaries exist between two primaries. Three tubercles are present on each primary.

Discussion – The incomplete preservation of this specimen makes difficult a reliable specific determination. Some morphologic similarities with *Ancyloceras* sp. figured by Delanoy (1997, pl. 7, fig. 2) from the *Deshayesites weissi* Zone of the Angles area (SE France) were observed.

Stratigraphic level – Metre 39.

Subgenus AUDOULICERAS Thomel, 1964

Type species – *Ancyloceras audouli* Astier, 1851.

? ANCYLOCERAS (AUDOULICERAS) cf. FALLAUXI (Uhlig, 1883)
Pl. 1, fig. 12

Material – 8249 (K 154), a crushed fragment coated with oxides.

Description – Fragment of a large specimen corresponding to the shaft, whose beginning is gently arched, crushed on the ventrolateral side. The ribs are fine and regularly spaced.

Discussion – The attribution to *Audouliceras fallauxi* is uncertain because the specimen is too incomplete. However, it shows strong similarities with the specimen figured by Uhlig (1883, pl. 29, fig. 1) that is characterized by the presence of tuberculated ribs in the initial whorls of the young, spiralate stage. The tubercles soon disappear and the sculpture remains made of fine, regularly spaced, simple ribs.

Stratigraphic level – Metre 39.

ANCYLOCERATIDAE gen. et sp. indet.

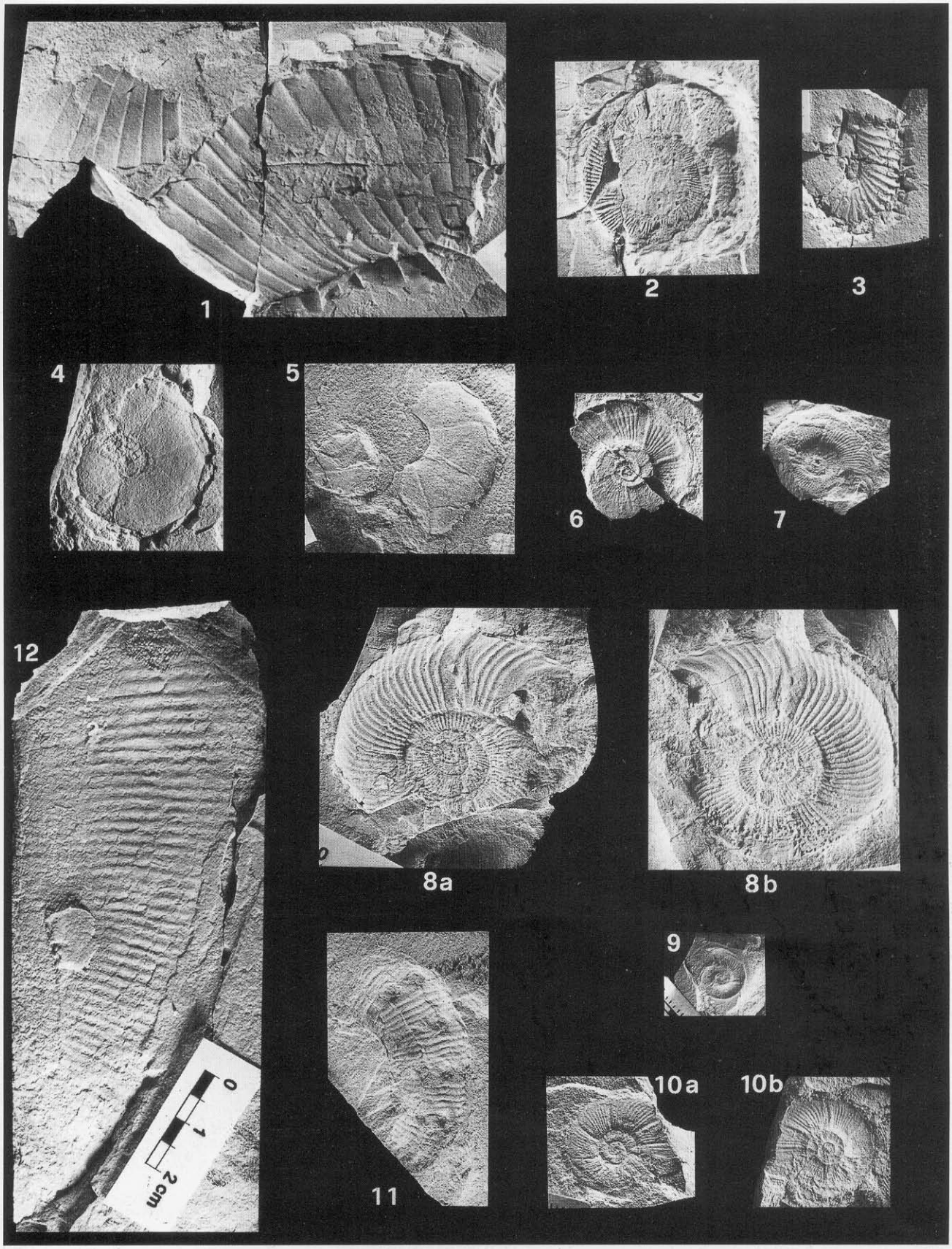
Material – 8229 (K118), a crushed fragment coated with oxides.

Description – A small fragment of a gently arched shaft. The whorl height increases rapidly. The sculpture is made of dense, simple ribs; interspaces about as wide as ribs.

Discussion – The ribbing of this fragment recalls that of specimen 8249 (K 154), determined as ?*Audouliceras* cf. *fallauxi* (Uhlig). However, we cannot ascribe it to this species because of the incomplete

EXPLANATION OF PLATE 1

Fig. 1 - *Eulytoceras phestum* (Matheron). Cesana Brianza, Section C, m 39. N. 8243 (K141); x 1.
Fig. 2 - *Costidiscus recticostatus* (d'Orbigny). Cesana Brianza, Section C, m 34.75. N. 8236 (K128); x 1.
Fig. 3 - *Macroscaphites* sp.Cesana Brianza, Section C, m 39.3. N. 8247 (K149); x 1.
Fig. 4 - *Melchiorites* cf. *melchioris* (Tietze). Cesana Brianza, Section C, m 39.1. N. 8254 (K162); x 1.
Fig. 5 - *Melchiorites* cf. *melchioris* (Tietze). Cesana Brianza, Section C, m 39. N. 8260 (K171); x 1.
Fig. 6 - *Silesites* aff. *seranonis* (d'Orbigny). Cesana Brianza, Section C, m 34.1. N. 8219 (K101); x 1.
Fig. 7 - *Silesites* aff. *seranonis* (d'Orbigny). Cesana Brianza, Section C, m 34.1. N. 8221 (K103); x 1.
Fig. 8 a, b - *Silesites* aff. *seranonis* (d'Orbigny). Cesana Brianza, Section C, m 31.2. N. 8239 (K137); x 1: a) internal mold; b) impression.
Fig. 9 - *Silesites* aff. *seranonis* (d'Orbigny). Cesana Brianza, Section C, m 34.1. N. 8227 (K113); x 1.
Fig. 10 a, b - *Silesites* aff. *seranonis* (d'Orbigny). Cesana Brianza, Section C, m 34.1. N. 8220 (K102); x 1: a) internal mold; b) impression.
Fig. 11 - *Ancyloceras* sp. Cesana Brianza, Section C, m 39. N. 8241 (K 139); x 1.
Fig. 12 - ?*Ancyloceras (Audouliceras)* cf. *fallauxi* (Uhlig). Cesana Brianza, Section C, m 39. N. 8249 (K154); x 1.


1
2
3
4
5
6
7
12
8a
8b
9
11
10a
10b
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1
2 cm

preservation and lack of diagnostic features. Furthermore, the size of *A. fallauxi* is far larger.

Stratigraphic level – Metre 34.8.

Subfamily LEPTOCERATOIDINAE Thieuloy, 1966

Genus LEPTOCERATOIDES Thieuloy, 1966

Type species – *Crioceras (Leptoceras) pumilum* Uhlig, 1883.

LEPTOCERATOIDES HOHENEGGERI (Vasicek & Wiedmann, 1994)
Pl. 2, figs. 1-4

1994 *Karsteniceras hoheneggeri* VASICEK & WIEDMANN, p. 215, pl. 2, fig. 9; pl. 3, figs. 1-3; text-fig. 3 C-D (*cum syn.*)

Material – Seven crushed specimens whose sculpture is imperfectly preserved: 8224 (K 107), 8232 (K 121), 8233 (K 122), 8233 (K 123), 8233 (K 125), 8234 (K 126), 8235 (K 127). All the specimens are observable on one side only. Both the ventral area and the embryonal part of the shells are not visible.

Dimensions (in mm) –

specimen	D	Uw	Wh	K
8224 (K 107)	26	11.5 (0.44)	8.5 (0.33)	19
8232 (K 121)	19.5	10 (0.51)	7 (0.36)	19
8233 (K 122)	16	-	5.5 (0.34)	-
8233 (K 125)	18	7 (0.39)	6.5 (0.36)	K/2-9
8234 (K 126)	17.5	7.25 (0.41)	6.5 (0.37)	18

Description – Small, planispiral shells with criocone coiling. They bear relative rare simple, distant (interspaces as wide as two ribs), elevated ribs with marginal thickening. The largest shell reaches the diameter of 26 mm. The suture-line is not preserved.

Discussion – The described shells have a relatively small diameter that might indicate the lack of the body chamber or, alternatively, their juvenile stage of growth. However, the lack of preserved sutures does not allow us to confirm any of the hypotheses. The shells are characterized by distant ribs bearing marginal thickenings at their ventrolateral ends. This character recalls *L. hoheneggeri* in the stage of growth that preceeds the development of constrictions, i. e., the last part of the body chamber of fully grown specimens.

According to the more recent findings in the Lower Barremian of the Silesian Unit (Vasicek & Klajmon, 1998), the genus *Karsteniceras* includes only the trochospiral coiled shells with irregular marginal tubercles. The planispiral shells without tubercles or with the regular marginal tubercles on each rib should be included in the genus *Leptoceratoides*. The juvenile whorls of some species of *Imerites* can develop similar ribbing. However, the embryonal part of *Imerites* shows a helicoidal coiling and at the same diameter its whorls are higher. Unfortunately this stage is not preserved in our material. Furthermore, *Imerites* bears ventral furrow but this character cannot be observed on our specimens.

The detailed stratigraphic position of the type material of the Silesian Unit is unknown. The specimens collected by W. Kuhnt in the Breggia Gorge (Southern Alps, Switzerland) are of Late Barremian age (Vasicek & Wiedmann, 1994). The material from Italy with the associated ammonites indicates the interval straddling the Barremian/Aptian boundary.

Stratigraphic level – All specimens from metre 34.1.

Family PTYCHOCERATIDAE Meek, 1876

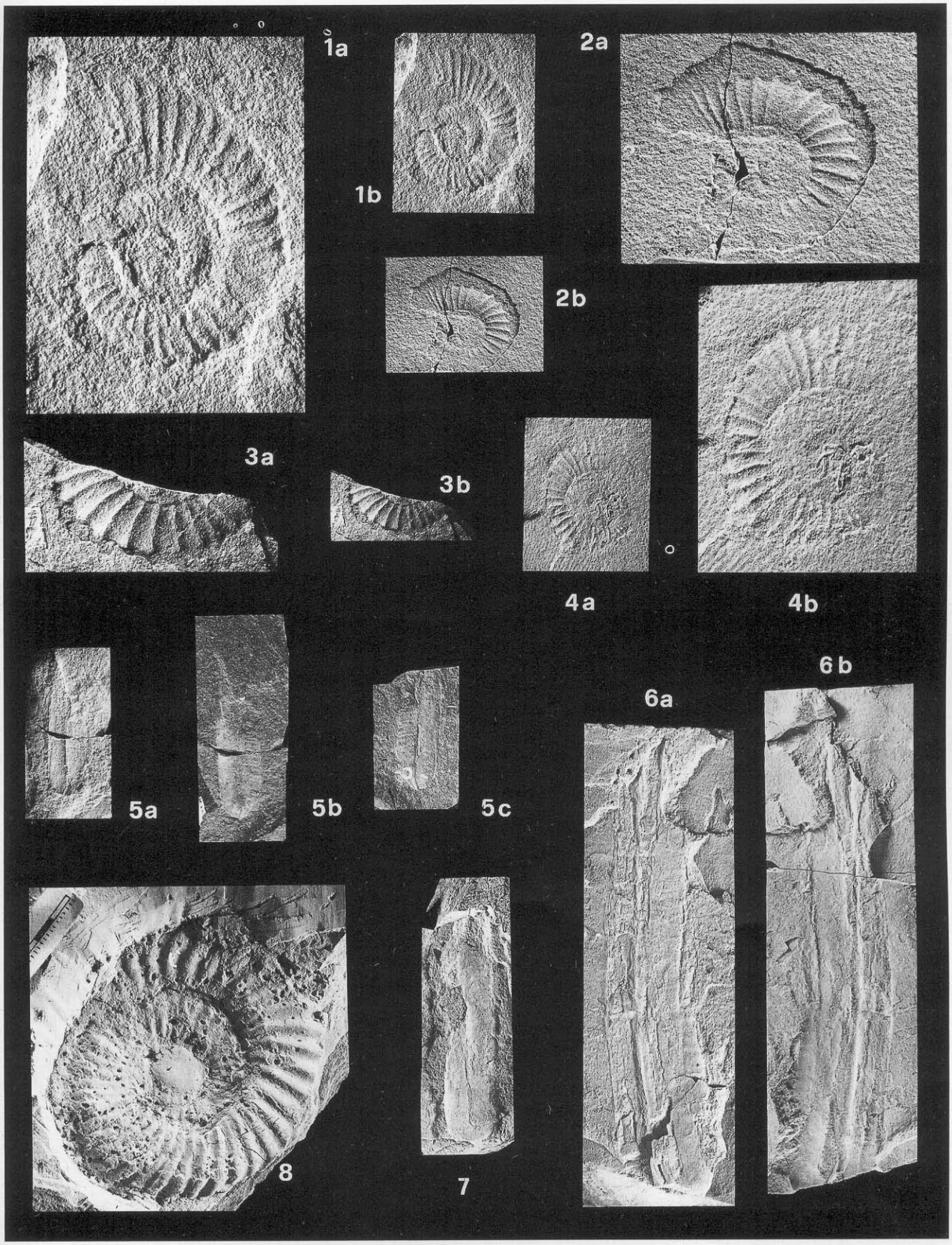
Genus PTYCHOCERAS d'Orbigny, 1842

Type species – *Ptychoceras emericianum* d'Orbigny, 1842.

Wright (*in* Wright *et al.*, 1996) has newly proposed the distinction of *Ptychoceras* from *Euptychoceras* on the basis of very poor morphologic differences. According to the opinion already expressed by two of us (Cecca & Landra, 1994), we keep on considering the latter a mere synonym of the former.

EXPLANATION OF PLATE 2

Fig. 1 a,b - *Leptoceratoides hoheneggeri* (Vasicek & Wiedmann). Cesana Brianza, Section C, m 34.1. N. 8224 (K 107): a) x 2; b) x 1.
Fig. 2 a, b - *Leptoceratoides hoheneggeri* (Vasicek & Wiedmann). Cesana Brianza, Section C, m 34.1. N. 8234 (K 126): a) x 2; b) x 1.
Fig. 3 a, b - *Leptoceratoides hoheneggeri* (Vasicek & Wiedmann). Cesana Brianza, Section C, m 34.1. N. 8235 (K 127): a) x 2; b) x 1.
Fig. 4 a, b - *Leptoceratoides hoheneggeri* (Vasicek & Wiedmann). Cesana Brianza, Section C, m 34.1. N. 8232 (K 121): a) x 2; b) x 1.
Fig. 5 a, b, c - *Ptychoceras poni* (Simionescu). Cesana Brianza, Section C, m 34.1. N. 8222 (K105); x 1: a) internal mold coated with ammonium chloride; b) internal mold not coated; c) impression not coated.
Fig. 6 a, b - *Ptychoceras* cf. *meyrati* (Ooster). Cesana Brianza, Section C, m 31.2. N. 8240 (K138); x 1: a) internal mold; b) impression on the sediment.
Fig. 7 - *Ptychoceras* cf. *meyrati* (Ooster). Cesana Brianza, Section C, m 39. N. 8263 (K175); x 1.
Fig. 8 - *Procheloniceras* cf. *sporadicum* (Rouchadze). Cesana Brianza, Section C, m 34.1. N. 8231 (K 120); x 1.


1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
5c
6a
6b
7
8

PTYCHOCERAS PONI Simionescu, 1898
Pl. 2, fig. 5

1898 *Ptychoceras poni* SIMIONESCU, p. 65, pl. 1, fig. 12.

Material – One internal mould and its cast partially coated with oxides 8222 (K 105).

Dimensions (in mm) –

specimen	Ls1	hs1	hb1	Ls2	hs2	hb2	Ls3	hs3
8222 (K 105)	16	2.25	-	32.5	3.75	5.5	15.5	4.5

Description – This heteromorph shell presents three shafts: the first shaft is in contact with the second one and its length is about half of the second. The third shaft is not in contact, although very close, with the second. The second bend bears a constriction followed by an adoral swollen margin. The first shaft and most of the second shaft are smooth, whereas simple, weak, closely spaced ribs appear (interspaces about as wide as ribs) on both the last 10 mm of the second shaft and the third shaft.

Discussion – This specimen shows some morphologic affinities with *P. emerici* (d'Orbigny) figured by Avram (1976, pl. 2, fig. 8), although the presence of a constriction in the bend between the two shafts makes this specimen closer to *Ptychoceras poni* Simionescu.

Stratigraphic level – Metre 34.1.

PTYCHOCERAS cf. MEYRATI Ooster, 1860
Pl. 2, figs. 6, 7

Material – 8240 (K 138), 8263 (K 175).

Dimensions (in mm) –

specimen	Ls1	hs1	hb1	Ls2	hs2	hb2	Ls3	hs3
8240 (K 138)	~58	~5	-	~90	~7	-	-	~7
8263 (K 175)	-	-	~5	-	-	-	-	-

Description – Shell characterized by three straight shafts. The first and the second shaft are in contact except for the area near the bending, the third shaft is in contact with the second for the first 25 mm then it slightly overlaps the first one. The last part of the third shaft is missing. The shell is smooth and no evidence of sculpture has been observed. Specimen 8263 (K 175) has been interpreted as corresponding to the first two shafts.

Discussion – Specimen K 138 closely resembles *P. meyrati* described from an Upper Barremian level of the same quarry (Cecca & Landra, 1994); the two specimens also share the same dimensions. The ridges on the third shaft are not evident. *Ptychoceras meyrati* is a long-ranging species recorded from Lower Hauterivian to Upper Barremian levels (Cecca & Landra, 1994). Its presence in the Lower Aptian has been also reported by Braga *et al.* (1982).

Stratigraphic level – Specimen 8240 (K 138) from metre 31.2; specimen 8263 (K 175) from metre 39.

PTYCHOCERAS sp. (form 1)

Material – 8223 (K106).

Description – Incomplete specimen with the bend and fragments of two parallel shafts preserved for a length of 10 mm. The shell is smooth.

Discussion – This specimen can be considered close to *Ptychoceras minimum* Rouchadze because of its small size and the lack of sculpture. The ratio between the length of the two shafts of our specimen is similar to *P. minimum*, but its size is slightly larger and a constriction occurs on the bend. This last character is absent in the type-specimens described by Rouchadze (1933). Simionescu (1900, p. 11) described a furrow near the bend of some French specimens that he ascribed to his species *Ptychoceras inornatum* Simionescu, although the holotype lacks this character (Simionescu, 1898). *P. inornatum* is also characterized by a far larger size than our specimen and is described from Hauterivian levels and doubtfully from Barremian ones.

Stratigraphic level – Metre 34.1.

Family MACROSCAPHITIDAE Hyatt, 1900

Genus MACROSCAPHITES Meek, 1876

Type species – *Scaphites yvani* Puzos, 1831.

Costidiscus Uhlig has been treated as a synonym of *Macroscaphites* Meek by Wright (*in* Wright *et al.*, 1996), who formalized Avram's (1984) conclusions on dimorphism of this pair from the nomenclatorial point of view. The former is considered the macroconch, the latter the microconch. However, as also stressed by Avram (1984), it is difficult to arrange all the different *Macroscaphites* and *Costidiscus* morphospecies in dimorphic pairs corresponding to biological species. Therefore, we maintain these forms as a discrete taxa considering *Costidiscus* as a subgenus. This taxonomic approach is common in Jurassic ammonites (Zeiss, 1968; Callomon, 1969; Westermann, 1989).

MACROSCAPHITES (M.) sp.
Pl. 1, fig. 3

Material – A crushed fragment 8247 (K 149).

Description – The specimen corresponds to a fragment of the last part of the shaft and the beginning of the bend of a heteromorph ammonite. The ribs are fine, sharp, spaced and prorsiradiate on the shaft, radial on the bend. A radial constriction marks the end of the bend.

Discussion – The fragment can be ascribed to the genus *Macroscaphites* because morphologically similar bends and shafts of *Anahamulina* or *Hamulina* bear differently shaped ribs. It is impossible to identify the species because the distinctive specific characters are usually developed in the normally coiled part of the shell which is lacking in our specimen.

Stratigraphic level – Metre 39.3.

Subgenus COSTIDISCUS Uhlig, 1883

Type species – *Ammonites recticostatus* d'Orbigny, 1841.

MACROSCAPHITES (COSTIDISCUS) RECTICOSTATUS (d'Orbigny, 1841)
Pl. 1, fig. 2

1841 *Ammonites recticostatus* d'ORBIGNY, p. 134, pl. 40, figs. 3, 4.
1994 *Costidiscus recticostatus* (d'Orbigny) - CECCA & LANDRA, p. 403, pl. 1, figs. 1,2 (*cum syn.*).
1994 *Costidiscus recticostatus* (d'Orbigny) - VASICEK *et al.*, p. 55, pl. 21, fig. 4.
1995a *Costidiscus recticostatus* (d'Orbigny) - DELANOY, pl. 6, fig. 5.
1995 *Costidiscus recticostatus* (d'Orbigny) - CECCA *et al.*, pl. 3, fig. 14.
1995 *Costidiscus recticostatus* (d'Orbigny) - AVRAM, pl. 12, fig. 10; pl. 13, fig. 1.
1995b *Costidiscus recticostatus* (d'Orbigny) - DELANOY, pl. 5, fig. 4.
1997 *Costidiscus recticostatus* (d'Orbigny) - DELANOY, pl. 4, fig. 1; pl. 5, fig. 4.

Material – 8236 (K 128), crushed specimen.

Dimensions (in mm) –

specimen	D	Uw	Wh	K
8236 (K 128)	32	-	8 (0.25)	48

Discussion – The specimen shows the typical characters of this species. The presence of constrictions has been already discussed by Cecca & Landra (1994, p. 404): even in older, Late Barremian, specimens from northern Italy constrictions are constantly present.

Stratigraphic level – Metre 34.75.

MACROSCAPHITES (COSTIDISCUS) sp.

Material – Specimens 8244 (K 142), 8256 (K 166).

Discussion – Two specimens are ascribed to this genus but they could not be identified at specific level. Only the specimen 8244 (K 142) shows some affinities with *C. recticostatus.*

Stratigraphic level – 8244 (K 142) from metre 24.5; 8256 (K 166) from metre 34.1.

Superfamily DOUVILLEICERATACEAE Parona & Bonarelli, 1897
Family DOUVILLEICERATIDAE Parona & Bonarelli, 1897
Subfamily CHELONICERATINAE Spath, 1923

Genus PROCHELONICERAS Spath, 1923

Type species – *Ammonites stobieckii* d'Orbigny, 1850.

PROCHELONICERAS cf. SPORADICUM (Rouchadze, 1933)
Pl. 2, fig. 8

Material – 8231 (K120), internal mould.

Dimensions (in mm) –

specimen	D	Uw	Wh	K/2
8231 (K 120)	55	27.5 (0.5)	15 (0.27)	21

Description – Evolute shell with the sculpture characterized by simple, prominent and regularly spaced ribs bearing two rows of tubercles. The internal whorls are not visible; however, up to d~35 mm it is possible to observe lateral, rather strong, tubercles located at the upper third of the flank. Then they disappear and the ribs develop a tubercle-like thickening at the ventrolateral margin. A less pronounced, periumbilical, row of tubercles appears in the preserved portion of the last whorl and it moves slowly higher on the flank as the relief of the tubercle increases.

Discussion – The specimen bears a higher number of ribs per whorl than all the other species of this genus. The only species showing some morphologic similarities is *Procheloniceras sporadicum.* In fact, our specimen could be comparable to the inner whorls of the holotype (Rouchadze, 1933, p. 192, pl. 3, fig. 3) that are unfortunately poorly preserved.

Spinocrioceras amadei (Uhlig), a species reported from the latest Barremian *Martelites sarasini* Zone (Delanoy, 1992, 1995 b), shows some morphologic similarities with our specimen, although its ribs are stronger and more spaced.

Unfortunately our specimen does not bear any trace of suture. According to Delanoy (1992, p. 80), the distinction between the genera *Procheloniceras* and *Spinocrioceras* is based on sutural characters, i. e., the former bears the 1st lateral saddle higher than the second one.

Stratigraphic level – Metre 34.1.

BIOSTRATIGRAPHY

Within the described fauna no zonal markers occur and the biostratigraphic assignment of the sampled levels can be indirectly stated on the basis of the data obtained with other stratigraphic methods and from the literature. The Mediterranean ammonite assemblages show a remarkable stability during the Barremian - Aptian transition (Braga *et al.*, 1982; Cecca & Landra, 1994; Aguado *et al.*, 1997).

The scarcity in the Mediterranean areas of representatives of the family Deshayesitidae, which is abundant in Boreal areas or in Peri-Tethyan epicontinental platforms (e. g., Turkmenistan), makes the identification of the Barremian/Aptian boundary problematic. This has been stressed recently by Aguado *et al.* (1997, p. 316), who also noted the difficulties to recognize the Early Aptian *D. tuarkyricus* and *D. weissi* Zones. In fact, these authors have studied a very rich fauna of approximately 3500 specimens and only one specimen of *Deshayesites* is reported from the beds presumably corresponding to the *D. tuarkyricus* Zone.

The Early Aptian age of our fauna could be subjected to criticism because *Ptychoceras meyrati* is a long-ranging species, and *Audouliceras* is mainly recorded in the Upper Barremian (Delanoy, 1992, 1995b), although its vertical range reaches the *D. weissi* Zone (Delanoy, 1997). The fragment determined as *Ancyloceras* sp. (Pl. 1, fig. 11) resembles the specimen of the *D. weissi* Zone figured by Delanoy (1997, pl. 7, fig. 2). The genus *Procheloniceras* indicates the Early Aptian but the characters of the suture-line are necessary to distinguish it from the morphologically similar *Spinocrioceras* of Late Barremian age (Delanoy, 1992; Aguado *et al.*, 1997); the suture-lines are not preserved in the specimen that we have tentatively identified as *P.* cf. *sporadicum*. The range of *Silesites seranonis* spans from the Upper Barremian to the Lower Aptian, but the specimens of *Silesites* found in the studied levels probably belong to a new species. Similar specimens have been assigned to the Late Barremian by Avram (1995) and by Druschits (1960), although Uhlig's (1883, pl. 18, fig. 4) specimen come from the locality of Malenowice (= Mallenowitz in Uhlig, 1883) where numerous Early Aptian species were collected. The type-specimens of *Melchiorites melchioris* are of Late Barremian age (Avram, 1978), but variants of Early Aptian age also exist. However, the preservation of our specimens is not sufficient to distinguish the morphological characters of the different variants.

Nevertheless, in our section (1) E. Erba (*in* Cecca & Landra, 1994) recognized the FO of the calcareous nannofossil *R. irregularis* at metre 2.95: this event has been recorded within the ammonite *M. sarasini* Zone (Cecca *et al.*, 1994b; Aguado *et al.*, 1997); and (2) Channell *et al.* (1995) recognized the base of the reversed chron CM0 at metre 4.5 and the top at metre 23 (see Text-fig. 3). Although there are no direct correlations between chron CM0 and ammonite biozones, a Deshayesitidae was found in the reversed interval of chron CM0 of the Gorgo a Cerbara section (Marche Apennines, Central Italy). The previous assignement of this specimen to the genus *Prodeshayesites* (Cecca *et al.*, 1995) was questioned (Rawson, pers. comm. to F. C., September 1995; Aguado *et al.*, 1997); after re-examination it should be identified as *Deshayesites* sp., thus indicating an Early Aptian age.

Moreover, most of the ammonitiferous levels of Section C are stratigraphically higher than metre 23 and fall within the normal interval above magnetic chron CM0 (Text-fig. 2). We conclude that their age is Early Aptian.

The ammonite fauna from metre 39.1 to 39.5 belongs to the LSE and some further consideration can be added. In Section C (1) the global nannoconid crisis (Erba, 1994) is documented below LSE, at about metre 36 (Channell *et al.*, 1995) (see Text-fig. 3). This event is 260 kyr younger than the top of chron CM0 (Erba, 1996, fig. 5) and probably occurs above the ammonite-bearing levels of the *D. weissi* Zone studied by Aguado *et al.*, (1997, p. 319); (2) the FO of *E. floralis* is recorded about 6 metres above the top of LSE in the overlying Marne di Bruntino Fm. (Erba *in* Bersezio, 1994). According to Keupp & Mutterlose (1994) the latter datum occurs in the ammonite *D. deshayesi* Zone, whilst Moullade *et al.* (1998) recognized it higher, at the base of the *Dufrenoyia furcata* Zone. These data indicate for the LSE an age ranging from the *D. weissi* to the *D. deshayesi* Zone (see Text-fig. 2).

PALAEOBIOGEOGRAPHICAL AND PALAEOECOLOGICAL REMARKS

The most obvious question arising from the discussion above is why the latest Barremian and Early Aptian age-diagnostic taxa, such Heteroceratidae, *Kutatissites*, *Deshayesites*, *Cheloniceras*, etc. are absent in our area. We believe that both palaeobiogeographic and palaeoecologic factors controlled the composition of the faunal assemblage.

Although less frequent than in the epicontinental seas of Europe and Central Asia, the taxa mentioned above occur in deep-basin successions of southern Spain and southern France (Aguado *et al.*, 1997; Delanoy *et al.*, 1997). According to the palaeogeographic reconstructions, the Lombardy basin was located in the Mediterranean Tethys in a more distal area far from the European and African margins (Winterer & Bosellini, 1981; Wieczorek, 1988).

In southern Spain and southern France the Aptian ammonite assemblages are typically Mediterranean (Cecca, 1998). The faunas collected in our section contain Mediterranean taxa only and are characterized by the dominance of long-ranging species. The absence of other Mediterranean taxa, particularly the

short-lived age-diagnostic ones, leads us to define our fauna as an "impoverished Mediterranean fauna".

The resulting stability of the ammonite assemblages around the Barremian/Aptian transition is probably related to adaptation to distal, epioceanic environments. These were more stable than the epicontinental seas because they were not affected by sea-level fluctuations.

Almost all fossiliferous levels of our section are dark, or black, shales particularly those of the equivalent of the "Livello Selli". Taking into account the speculations on supposed ammonite life-habitats, the demersal forms, feeding on sea-bottoms, should be very rare or even absent in the anoxic levels (Batt, 1993). The majority of the taxa recorded in our section had an epipelagic mode of life: in particular Lytoceratina, Phylloceratina, Ancyloceratidae and *Ptychoceras* probably were vertical migrants in the water column (Westermann, 1996). Vasicek & Wiedmann (1994) already noted that the biotope of the Leptoceratoidinae subfamily was close to stagnant, poorly oxygenated environments where they usually occur concentrated in "nests", dominating the faunal spectrum. This has been recently interpreted as an opportunistic behaviour in unfavourable environments (Cecca, 1998). Nothing can be said about the mode of life of *Melchiorites* and *Silesites*. The former belongs to the family Desmoceratidae, whose highest frequencies are recorded in marly, deep successions (Cecca, 1998). The latter is abundant (and even dominant in some beds) in deep successions of the Adria microplate, both in calcareous and shaly facies. Probably these taxa also lived in the water column.

In summary, most of the ammonites represented in the studied levels were not constrained to sea-bottoms, their feeding habits being probably related to the plankton living in the water column (Cecca, 1997, 1998). According to Batt (1993), the ammonite shell morphotypes represented in the fossil assemblage provide a tool in interpreting fluctuations in oxygen levels in marine deposits. On the basis of the ammonite morphotypes found at Cesana Brianza, the anoxic watermass did not reach the upper part of the water column but was close to the bottom.

AKNOWLEDGEMENTS

The authors are deeply indebted to I. Premoli Silva and E. Erba (Milano) for continuous help and stimulating advices, the text has much benefited their suggestions.

H.G. Owen (London), P. Hoedemaeker (Leiden) and a third anonymous referee are thanked for careful reading and constructive criticism. G. Chiodi (Milano) printed the photographs.

This work is supported by C.N.R. (Consiglio Nazionale delle Ricerche) Gruppo Palaeopelagos - Sottoprogetto Stratigrafia Integrata del Cretacico Pelagico (IPS).

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(*manuscript received June 29, 1998*
accepted April 27, 1999)

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