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The Douvilleiceratidae (Ammonoidea) of the Lower Aptian historical stratotype area at Cassis-La Bédoule (SE France).

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Abstract: Recent biostratigraphic research in the marly limestones of the Cassis-La Bédoule area (SE France) provided a rich macrofauna of Douvilleiceratidae PARONA & BONARELLI, 1897. From the uppermost Barremian (Pseudocrioceras waagenoides Subzone) to the middle Aptian (Parahoplites melchioris Zone), specimens of Procheloniceras, Cheloniceras, Roloboceras, Megatyloceras and Epicheloniceras were collected in succession. In this paper we describe the various genera and species from this material and delimit precisely their stratigraphic positions. Our study shows that each genus or subgenus characterizes a discrete stratigraphic interval. In addition, the Cheloniceras meyendorffi (upper Bedoulian), Epicheloniceras debile, Epicheloniceras gracile, and Epicheloniceras buxtorfi (Gargasian = middle Aptian) subzones, originally defined in England by CASEY (1961a), are identified for the first time in the Lower Aptian stratotypic area of Cassis-La Bédoule.

Key Words: Cretaceous; Aptian; ammonites; Douvilleiceratidae; taxonomy; biostratigraphy.

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Résumé : Les Douvilleiceratidae (Ammonoidea) de la région du stratotype historique de l’Aptien inférieur à Cassis-La Bédoule (SE de la France).- Des recherches biostratigraphiques récentes dans les sédiments barrémo-aptiens du secteur de Cassis-La Bédoule (SE de la France) ont révélé une riche macrofaune de Douvilleiceratidae PARONA & BONARELLI, 1897. Du Barrémien terminal (Sous-zone à Pseudocrioceras waagenoides) à l’Aptien moyen (Zone à Parahoplites melchioris) nous avons recueilli, de bas en haut, d’abord des spécimens de Procheloniceras, puis de Cheloniceras, Roloboceras, Megatyloceras et Epicheloniceras. Dans cet article nous décrivons et situons stratigraphiquement les différents genres et espèces de ce matériel. Notre étude montre que chaque genre ou sous-genre caractérise un intervalle stratigraphique particulier. De plus, les sous-zones à Cheloniceras meyendorffi (Bédoulien supérieur), Epicheloniceras debile, Epicheloniceras gracile et Epicheloniceras buxtorfi (Gargasien = Aptien moyen), définies à l’origine par CASEY (1961a) en Angleterre, sont reconnues pour la première fois dans la région stratotypique de l’Aptien inférieur de Cassis-La Bédoule.

Mots-Clefs : Crétacé ; Aptien ; ammonites ; Douvilleiceratidae ; taxinomie ; biostratigraphie.

1. Introduction

In recent decades several zonal and subzonal schemes based on ammonites have been proposed for the subdivision of the Barremian-Aptian interval, such as those of CASEY, 1961a (South England); BOGDANOVA, 1971 (Turkmenistan); RAWSON, 1983 (Corre-
ation of French, English and North German Aptian zonal schemes); KOTETISHVILI, 1986 (Georgia); DELANOE, 1997 (Vocontian Basin); MOULADE et alii, 1998 (Lower Aptian stratotype at Cassis-La Bédoule); ROPOLO et alii, 2000, 2006 (Lower Aptian stratotype); DAUPHIN, 2002 (Vocontian Basin). Based on these works, progressively updated schemes have been retained for the Mediterranean Region by the IUGS working groups (HOEDEMAEKER, BULOT et alii, 1990; HOEDEMAEKER, COMPANY et alii, 1993; HOEDEMAEKER, CECCA et alii, 1995; HOEDEMAEKER, RAWSON et alii, 2000; HOEDEMAEKER, REBOULET et alii, 2003; REBOULET, HOEDEMAEKER et alii, 2006).

The present consensus, still provisional and in the form of recommendations, is as follows:

- Uppermost Barremian: heteromorphic ammonites, such as Martelites sarasini and Pseudocrioceras waagenoides, are chosen as species-index.
- Lower and middle Aptian: representatives of three families (Deshayesitidae, Douvilleiceratidae and Parahoplitidae) are used as markers of zones, subzones or horizons. The Deshayesitidae are considered as the characterizing group for all the main subdivisions of Lower Aptian. Thus, the recent revision (ROPOLO et alii, 2006) of the Lower Aptian historical stratotype of Cassis–La Bédoule (SE France) has led to an identification and description of the species and the precise delimitation of the stratigraphic position of all the Deshayesitidae collected there, and also a proposal for a zonal subdivision using the succession of the Paradeshayesites oglanlensis, Paradeshayesites weissi, Deshayesites deshayesi and Dufreneyia furcata zones. Accessorily, a Roloboceras hambrovi horizon has been recognized in the middle part of the Deshayesites deshayesi zone, just below a Paradeshayesites grandis subzone.
- the Barremian/Aptian boundary is placed at the FAD (first appearance datum) of the genus Deshayesites and the Lower /middle Aptian boundary is defined as being at the upper limit of the Paradeshayesites grandis subzone.

To characterize the Lower and middle Aptian zones even better and to complete the description of the faunal content of the Cassis-La Bédoule type-area, in this paper we describe and locate stratigraphically the populations of Douvilleiceratidae that occur in the Bedoulian together with representatives of the genus Deshayesites, as well as the Douvilleiceratidae which are also found in the Gargasian. We thus study in detail the genera Procheloniceras, Cheloniceras, Epicheloniceras, Roloboceras and Megatyloceras. Changes in the sub-zonal boundaries are proposed on the basis of new discoveries of specimens of Cheloniceratinae collected in situ. These additional data are of major importance for a more thorough definition of the Lower and middle Aptian biostratons and make correlations between the Tethyan and Boreal realms easier.
2. Biostratigraphy

2.1. Faunal data

Five sections were investigated in the vicinity of Roquefort-La Bédoule (Les Caniers, Les Fourniers) and Cassis (Le Brigadan, Comte quarry, La Marcouline quarry) (Fig. 1). These outcrops made it possible to build a continuous composite section that includes strata ranging in age from Late Barremian to late Gargasian, with the exception of the Bedoulian/Gargasian transition (see below).

The material collected spans a time interval which includes the Late Barremian Sarasini Zone, the Early Aptian Oglanlensis, Weissi, Deshayesi, Furcata zones and the middle Aptian Martini and Melchioris zones.

Our record shows that three faunal intervals can be clearly identified in the stratotype area on the basis of the distribution of the Douvilleicicatidae (more particularly the Cheloniceratinae):

- a Procheloniceras level (beds 46 to 121 in the Cassis-La Bédoule railway station section) including the main part of the Waagenoides Subzone, the Oglanlensis and the Weissi (pro parte) zones. In this interval, we collected several species of Procheloniceras: P. pachystephanum (UHLIG, 1883), P. albrechtiaustriae (HOHN. in UHLIG, 1883), P. stobieski (d’ORBIGNY, 1850) and P. dechauxi (KILIAND & REBOUL, 1915) (Figs. 2-3).

- a Cheloniceras level (beds 144 to 178 in the Cassis-Comte quarry section and beds M3-M8 in La Marcouline quarry), which comprises the late Bedoulian Deshayesi and Furcata zones and the lowest beds of the middle Aptian. The following species were collected: Cheloniceras seminodosum (SINZOW, 1906); C. kiliani (KÖNEN, 1902); C. mackesoni CASEY, 1961; C. cornuelianum (d’ORBIGNY, 1841); C. parinodum CASEY, 1961; C. crassumSPATH, 1930; C. meyendorffi (d’ORBIGNY, 1841); C. disparile CASEY, 1961; C. minimum CASEY, 1961 (Figs. 3-5).

Within the Deshayesi Zone is included a Roloboceras/Megatylcoceras interval (beds 148 to 170 at Cassis-La Bédoule), with Roloboceras hambrovi (FORBES, 1845); R. gr. transiens (CASEY, 1961); R. horridum (SPATH, 1930); Megatylcoceras ricordeanum (d’ORBIGNY, 1841); M. aff. coronatum (ROUCHADZE, 1933).
Figure 3: Lower Aptian (*pro parte*) composite section of the Cassis-La Bédoule area with the stratigraphic position of the collected Cheloniceratinae and Roloboceratinae.

- an *Epicheloniceras* level (beds M6-M81 at La Marcouline). At the base of this interval *Cheloniceras* is no longer present and *Epicheloniceras* appears. The species *Epicheloniceras martini* (d’*ORBIGNY*, 1841); *E. martinioides* *CASEY*, 1961; *E. debile* *CASEY*, 1961; *E. subnodosocostatum* (*SINZOW*, 1906); *E. eotypicum* *CASEY*, 1961; *E. gracile* *CASEY*, 1961; *E. buxtorfi* (JACOB & TOBLER, 1906); *E. waageni* (ANTHULA, 1899) and *E. tschernyschewi* (*SINZOW*, 1906) were collected here (Fig. 5).

2.B. Contribution of Douvilleiceratidae to Aptian biozonation

In addition to this informal subdivision based on successive generic faunal assemblages, the distribution of Douvilleiceratidae at Cassis (Figs. 2-5) made it possible to establish several zones and subzones (Fig. 6):

- late Bedoulian:
  - Hambrovi Subzone* (middle part of the Deshayesi Zone) (beds 148-160),
  - Meyendorffi Subzone (upper part of the Furcata Zone) (from bed 174 to at least as far as bed 178),
- early-middle Gargasian
  - Martini Zone (at least from bed M 6 to bed M 63), with three subzones, successively:
    - Debile (at least from bed M6),
    - Gracile (from bed M30),
    - Buxtorfi (from bed M51)

* The upper Bedoulian position of this subzone has recently been questioned by *MORENO et alii* (2007). We discuss this point in another paper (ROPOLÔ et alii, 2008).
The Melchioris Zone (from bed M 64 to at least bed M 81) is defined at La Marcouline by an association of several species belonging to the faunal group that commonly occurs with the index species. It was found in similar levels which crop out laterally a few km East of Roquefort-La Bédoule (to be published).

2.C. The Bedoulian-Gargasian boundary in the Lower Aptian stratotype

The lack of outcrops spanning the short interval between the top of the Comte quarry and the base of the la Marcouline quarry makes it impossible to be precise concerning continuity of the beds that include the Bedoulian/Gargasian transition (CONTE, 1994; MOULLADE et alii, 2004). The only sector of the Cassis-La Bédoule area where this transition could be studied, the Les Tocchis section at La Bédoule (MOULLADE et alii, 2000, 2004, 2005) was made inaccessible in the late sixties as a result of urbanization. Micropaleontological samples were taken there in 1962 by one of us (M.M.), but macrofossils were never collected. The correlation between the uppermost levels of the Comte quarry, the middle part of Les Tocchis and the lowermost levels of La Marcouline is based only on microfaunal data (MOULLADE et alii, 2005; ROPOLLO et alii, 2006). Thus, the levels of the last occurrences of Dufrenoyia furcata and Cheloniceras meyendorffi, as well as that of first occurrence of Epicheloniceras cannot be fixed, and consequently in the Lower Aptian stratotype the location of the Bedoulian-Gargasian boundary cannot be determined precisely. In this respect, recently studied sections at La Tuilière near Apt (DUTOIR, 2005; MOULLADE et alii, 2008) or in the Vocontian Basin (DAUPHIN, 2002) constitute more favorable localities in which to make this determination.

3. Systematic descriptions

In the following tables we will use the standard abbreviations generally accepted for the main shell parameters (Fig. 7):

- D = maximum diameter
- d = minimum diameter
- Wh = whorl height
- Uw = umbilical width
- Wb = whorl breadth
- K = number of ribs per half whorl
- Ph = diameter at the end of phragmocone
- (E) evolute morphotype
- (S/E) semi-evolute morphotype
- (I) involute morphotype

All measurements in mm.

Material: Specimens from the ROPOLLO collection are designated by numbers preceded by the mentions PRB for the Barremian, PRA for the Lower Aptian, PRAG for the middle Aptian (Gargasian). CONTE’s collection is labeled "C" for the Lower Aptian, and C.G. for the middle Aptian. The material from the Museum of Paleontology, University of Provence, Campus Saint-Charles (Marseilles) is labeled "Sc". A few specimens described here are from the DEROGNAT Collection. All collections are deposited in the University of Provence Museum.
Figure 5: Middle Aptian in the La Marcouline Quarry section, with the stratigraphic position of the collected Cheloniceratinae.

Family Douvilleicerasidae
PARONA & BONARELLI, 1897

Subfamily Cheloniceratinae
SPATH, 1923

Genus Procheloniceras
SPATH, 1923

Type-species: Ammonites stobieskii d’ORBIGNY, 1850a (p. 113, Lower Aptian of southeastern France).

Diagnosis: Ammonite slightly involute, generally of great size, with wide umbilicus, rounded whorls of medium thickness. Whorl section is wider than high. Ribs are strong, radial, or slightly inclined backward. They bear umbilical and lateral tubercles, the umbilicals being stronger than the lateral ones. Ribs are generally simple but some of them may bifurcate from the umbilical tubercle. Short secondary ribs are sometimes present on the young whorls, but the number of intermediate ribs is low.

Figure 6: Latest Barremian to middle Aptian biozonation in the stratotypical area of Cassis-La Bédoule, SE France. Upper Barremian / Lower Aptian bed numbering is that used in MOULLADE et alii (2000); middle Aptian bed numbering is specifically used in this paper for the La Marcouline Quarry section.
**Procheloniceras pachystephanum**  
(UHLIG, 1883)  
(Pl. 1, figs. 1-3)

1883 *Acanthoceras Pachystephanus* UHLIG 1883, p. 255, Pl. 24, figs. 1.a-b & 2; Pl. 25, fig. 1.  
1906 *Douvilleiceras pachystephanum* (UHLIG 1883); SINZOW, p. 169, Pl. 4, figs. 3.a-b.  
1915 *Douvilleiceras pachystephanum* (UHLIG 1883); KILIAN & REBOUL, p. 61, Pl. 3 fig. 4; Pl. 4, fig. 8; Pl. 8, figs. 1 & 4.  
1933 *Douvilleiceras pachystephanum* (UHLIG 1883); ROUCHADZE, p. 187.  
1960 *Procheloniceras pachystephanum* UHLIG; KUDRIAVTSEV, p. 336, Pl. 17, fig. 1; Pl. 19, figs. 1-2.  
1994 *Procheloniceras* gr. *pachystephanum*/albrechtiaustriae DELANOY, Pl. 6, fig. 4.  
1997 *Procheloniceras* gr. *pachystephanum*/albrechtiaustriae DELANOY, Pl. 24, fig. 7.  
1997 *Procheloniceras pachystephanum* (UHLIG); AQUADO et alii, Pl. 7, fig. a.  
1999 *Procheloniceras pachystephanum* (UHLIG); KOTETISHVILI et alii, p. 379, Pl. 91, figs. 1.a-b.  
2004 *Procheloniceras* sp. A SHARIKADZE et alii, p. 316-317, Pls. 5-6; p. 432-433.  
2005 *Procheloniceras pachystephanum* (UHLIG); KOTETISHVILI et alii, p. 379, Pl. 91, figs. 1.a-b.  
2005 *Procheloniceras pachystephanum* (UHLIG); AGUADO et alii, Pl. 7, fig. a.  
2005 *Procheloniceras pachystephanum* (UHLIG); ROPOLO et alii, Pl. 7, fig. 3.

Material: Three complete specimens: PRB 0419, PRA1320, PRA1322, several fragments.

Measurements:

| Specimen | D  | Wh | Uw | Wb  | K  | Ph | Wb/Wh | Morphotype |
|----------|----|----|----|-----|----|----|-------|------------|
| PRB0419  | 70 | 27 | 28 | 25.65 | 18 | 60 | 0.95  | E          |
| PRA1320  | 102| 40 | 38 | 38.4 | 18 | -  | 0.96  | E          |
| PRA1322  | 159| 49.8| 53.5| 49.3 | 18 | 122| 0.98  | E          |

Description: Evolute coronatiform ammonite, with wide oval whorl section, rounded venter and depressed wide umbilicus. Ribs are strong, radial, more often simple. Rare intermediate ribs are irregularly intercalated between main ribs. They can start from the umbical wall or from mid flank. All ribs pass straight over the venter. On the flanks, primaries bear strong umbilical and lateral tubercles, the umbilicals stronger than the laterals. Intermediate ribs, thinner, are non-tuberculate.

Discussion: Our specimens are slightly compressed, but are very similar to the forms illustrated by UHLIG (1883: Pl. 24, figs. 1.a-b & 2), with 18 strong ribs per half whorl. They differ from the form of Pl. 25, fig. 1, which shows a more prominent ornamentation and only 14 ribs per half whorl.

Occurrence: The vertical range of Procheloniceras pachystephanum seems to be very long. We collected this species from the Late Barremian *Pseudocrioceras waagenoides* Zone (Le Brigadan section), the Early Aptian *Paradeshayesites oglanlensis* (Les Caniers section) and *Paradeshayesites weissi* (Les Fourniers section) zones.

**Procheloniceras albrechtiaustriae**  
(HOHENEGGER, in UHLIG, 1883)

(Pl. 2, figs. 2-3; Pl. 3, figs. 1-2; Pl. 4, fig. 2)

1883 *Acanthoceras Albrechti-Austriae* HOHENEGGER in coll. UHLIG, p. 129, Pl. 22; Pl. 23, fig. 1.  
1902 *Acanthoceras Albrechti-Austriae* HOHENEGGER; KOENEN, p. 140, Pl. 41, fig. 1.  
1906 *Douvilleiceras Albrechti-Austriae* (HOHENEGGER); SINZOW, p. 167, Pl. 4, figs. 1-2.  
1915 *Douvilleiceras Albrechti-Austriae* (HOHENEGGER) UHLIG; KILIAN & REBOUL, p. 57, Pl. 1, fig. 6; non Pl. 3, fig. 5; Pl. 8, fig. 3.  
1927 *Douvilleiceras Albrechti-Austriae* (HOHENEGGER) UHLIG; ROCH, p. 20.  
1933 *Douvilleiceras Albrechti-Austriae* (HOHENEGGER); ROUCHADZE, p. 185, fig. 8.  
1958 *Procheloniceras albrechtiaustriae* (HOHENEGGER) LUPPOV, Pl. 65, fig. 1.  
1960 *Procheloniceras albrechtiaustriae* (HOHENEGGER); KUDRIAVTSEV, p. 335, Pl. 16, fig. 1.  
1967 *Procheloniceras albrechtiaustriae* (HOHENEGGER in UHLIG); DIMITROVA, p. 175, Pl. 81, fig. 4; Pl. 85, fig. 5.  
1972 *Procheloniceras albrechtiaustriae* (HOHENEGGER in UHLIG); VASICEK, p. 67, Pl. 10, fig. 6; Pl. 11, fig. 2.  
1995 *Procheloniceras albrechtiaustriae* (UHLIG); DELANOY, Pl. 7, fig. 1.  
1997 *Procheloniceras albrechtiaustriae* (UHLIG); VASICEK, Pl. 2, fig. 7.  
2004 *Procheloniceras albrechtiaustriae* (HOHENEGGER in UHLIG); SHARIKADZE et alii, p. 314-315, Pl. 1, fig. 1; Pl. 2, fig. 1; Pl. 3, fig. 1; Pl. 4, fig. 1.  
2005 *Procheloniceras albrechtiaustriae* (HOHENEGGER); KOTETISHVILI et alii, p. 380, Pl. 92, figs. 1.a-b & 2.a-b.

Material: Five complete specimens: Sc Dw403, Sc Dw302, Sc Dw12896, PRA1412, PRA1414 and numerous fragments and incomplete specimens.
Measurements:

| specimen   | D   | Wh  | Uw  | Wb   | K   | Ph  | Wb/Wh | morphotype |
|------------|-----|-----|-----|------|-----|-----|-------|------------|
| Sc Dw402   | 165 | 60  | 48.2| 52   | 22  | 120 | 0.88  | E          |
| Sc Dw302   | 163 | 66  | 47  | 51.6 | 22  | -   | 0.78  | E          |
| Sc Dx12396 | 156 | 56.5| 45  | 53   | 22  | -   | 0.93  | E          |
| PRA1412    | 148 | 39  | 40  | 51   | 20  | -   | 0.664 | E          |
| PRA1414    | 92  | 29.5| 22  | 25   | 19  | -   | 0.84  | E          |

Description: Evolute ammonite generally of large size with rounded inflated whorls. Section in the juvenile is wider than high, then, in the adult, it becomes higher than wide. Ornamentation of flanks consists of strong simple radial ribs bearing lateral and umbilical tubercles and of non-tuberculate intermediate ribs. Primaries start from the umbilical tubercle. Intercalatories originate generally from mid flank or from the first third of the flank. Between tubercles, main ribs are flattened. Then they rapidly become stronger. All the ribs pass straight over the ventral part. In this species, specific variability can be very important. Ribs are radial or slightly inclined backward, equal or variable in breadth, robust or rather weak. In the gerontic stage the ribs become more widely separated, intercalatories become as robust as the primaries and tubercles disappear. The umbilicus ranges in size from moderately to very wide. The number of ribs per half whorl varies from 14 to 24 according to diameter.

Figure 7: *Douvilleiceras* *Albrechtii-Austriae* (Hohenegger) Uhlig; in Kilian & Rebour, p. 57, Pl. 1, fig. 6, toptype (Institut Dolomieu Collection, Grenoble, France).

Discussion: Our material is similar to Uhlig's (1883) original illustrations (Pl. 22 & Pl. 23, fig. 1) in the general shape of the shell and in the sculpture. But the figure on Pl. 22 has more ribs (24) per half whorl and is probably a gerontic specimen. Our specimen labeled PRA1413 (Pl. 2, fig. 2) resembles more exactly Uhlig's Pl. 23, fig. 1. The specimen illustrated by Kilian & Rebour (1915: Pl. 1, fig. 6) differs in having more intermediate ribs which occur irregularly between the main ribs. Kilian & Rebour’s (1915: Pl. 3, fig. 5 and Pl. 8, fig. 3) listed under the name *Procheloniceras albrechti-austriae* are probably *Cheloniceras*.

Occurrence: *Procheloniceras albrechti-austriae* is well represented in paleontological collections, because it is the most common species of *Procheloniceras* collected in the Lower Aptian. Distribution: France (SE France, Drôme, Vocontian Basin, Vaucluse), Germany, Austria, Bulgaria, Poland, Romania, Czechia, North Caucasus, Russia, Georgia, Armenia, Mangyshlak (Kazakhstan), Mangyshlak (Iran), Colombia. At La Bédoule this species occurs throughout the lower part of the Lower Aptian *Paradeshayesites weissi* Zone (Les Fourniers section).

*Procheloniceras stobieskii* (d’Orbigny, 1850)

(Pl. 2, fig. 1; Pl. 5, figs. 1-4)

1850a Ammonites Stobieckii [sic] d’Orbigny, p. 113.
1889 Ammonites Stobieskii d’Orbigny; Kilian, p. 248.
1895 Ammonites Stobieskii [sic] d’Orbigny; Kilian, p. 752, infrap. note n° 3.
1915 *Douvilleiceras* *Albrechtii-Austriae* Hoh. sp. var. Stobieskii [sic] d’Orbigny; Kilian & Rebour, p. 51 & 58-61.
1927 *Douvilleiceras* *Albrechtii-Austriae* Hoh. sp. var. Stobieskii d’Orbigny; Roch, p. 20, Pl. 2.
1934 Procheloniceras albrechtii-austriae var. Stobieskii d’Orbigny; Denizot, p. 158.
1938 Procheloniceras albrechtii-austriae var. Stobieskii d’Orbigny; Roman, p. 425-426.
1981 Procheloniceras stobieskii (d’Orbigny); Conte, p. 65-70; p. 68, fig. 1.

Material: Three complete specimens Sc Dw301, PRA1417, PRA1420 and five fragments of whorls: PRA1418, 1421, 1422, 1423, 1427.
Discussion: D’ORBIGNY never figured the type of this species, but briefly described it in the "Prodrome" (1850, p. 113):

"Grosse espèce, voisine d’Ammonites mantelli, mais avec des pointes sur les grosses côtes près de l’ombilic et d’autres sur les côtés, en tout quatre rangées."

Figure 8: Procheloniceras stobieskii (d’ORBIGNY) specimen from the REQUIEN Collection, REQUIEN Museum – Avignon (France) (after CONTE, 1981 [Photograph BARTESAGO]).

KILIAN (1889, p. 248-249); KILIAN & REBOUL (1915, p. 59), without illustration or diagnosis, chose as the neotype of this species a specimen labeled by d’ORBIGNY himself (as "Ammonites Stobieskii - Ammonoïde du calcaire néocomien de Gigondas") which is included in the REQUIEN Collection deposited in the Avignon REQUIEN Museum (Fig. 8). Considering the similarities of this ammonite with the species figured by UHLIG, KILIAN & REBOUL named it "Douvilleiceras Albrechti-Austriae" var. "Stobiesckii" d’ORBIGNY.

Measurements:

| Specimen | D | Wh | Uw | Wb | K | Ph | Wb/Wh | Morphotype |
|----------|---|----|----|----|---|----|------|------------|
| Sc Dw302 | 145 | 48.2 (d6=113) | 38 | 24 (d=113) | 24 | - | 0.521 | I |

Description: Moderately involute corona-tiform shell with flanks slightly convex and whorls which increase slowly in height. Wide umbilicus. Ornamentation consists of radial, irregular single ribs starting from the umbilical wall becoming stronger and spatulate on the upper part of the flank with thinner intermediate ribs originating at the first third of the side from a periumbilical tubercle. Main ribs bear two distant, strong, thorn-like tubercles. One is situated near the umbilical wall, the other near the ventro-lateral margin. In the adult, tubercles disappear.

Discussion: Our specimen is very similar to the shell represented by KILIAN & REBOUL (1915: Pl. VII, fig. 2), but has more ribs per half whorl. It differs from Procheloniceras aff. dechauxi figured by SHARIKADZE et alii, Pl. 7, fig. 1; Pl. 8, fig. 1, in having a wider umbilicus and a higher whorl section.

Occurrence: The complete specimen Sc Dw302 is in the DEROGNAT Collection, deposited in the Museum of Paleontology, University of Provence, Campus Saint-Charles, Marseilles. It is labeled only "La Bédoule" and its exact stratigraphic position is unknown. However, we collected from bed 116 (Lower Aptian, Paradeshayesites weissi Zone), in the Les Fourniers section, a fragment of whorl (n° PRA1422) that we can attribute without doubt to this species.
Genus *Cheloniceras*

**HYATT 1903**

Type-species: *Ammonites cornuelianus d’ORBIGNY*, 1841 (p. 364, Pl. 112, figs. 1-2, Lower Aptian).

Diagnosis: Coronatiform in the juvenile stage, but in the adult it has a suboctagonal to wide-oval whorl section, wider than high. Venter can be flat or slightly rounded. Ornamentation consists of strong radial single ribs bearing a pair of tubercles or in primaries dividing into two secondaries starting at mid flank from the lateral tubercle and forming a two branched fork. All ribs pass straight across venter or sometimes are slightly curved forward. The periumbilical tubercle smaller than the lateral one is directed downwards. The lateral tubercle forms a right angle with the axis of the shell. In some species (*Cheloniceras cornuelianum, Cheloniceras mackesoni*...), one or two narrower secondary ribs, starting from a round conical umbilical tubercle are intercalated between the main ribs. Occasionally a tertiary rib may be present. Umbilicus is wide (about one-third the diameter, a little more on gerontic specimens) with a high and steep border.

Cheloniceras crassum

**SPATH, 1930**

(Pl. 6, figs. 1 & 3; Pl. 7, figs. 1-3)

1930 *Cheloniceras crassum* sp. nov. **SPATH**, p. 449, Pl. 15, fig. 6.

1961b *Cheloniceras (Cheloniceras) crassum* crassum **SPATH**; **CASEY**, p. 208, Pl. 34, figs. 2-6; Pl. 35, fig. 4.

1967 *Cheloniceras (Cheloniceras) crassum* crassum **SPATH**; **DIMITROVA**, p. 171, Pl. 86, fig. 1.

2004 *Cheloniceras (Cheloniceras) crassum* crassum **SPATH**; **SHARIKADZE et alii**, p. 328, PIs. 20-23; Pl. 24, fig. 1; Pl. 25.

Material: One measurable specimen; Sc Dw12609 (inner whorls are missing), numerous fragments of whorl (C.821, C.859, C.861...).

Measurements:

| specimen     | D   | Wh  | Uw | Wb  | K  | Ph  | Wb/Wh | morphotype |
|--------------|-----|-----|----|-----|----|-----|-------|------------|
| Sc Dw12609   | 181 | 62.2| ~44| 61  | 24 | -   | 0.980 | S/E        |

Description: Semi-evolute ammonite, with inflated flanks, rounded venter, depressed whorls, deep umbilicus. Whorl section is wide oval to suboctagonal. Ornamentation consists of radial ribbing, with alternating long and flat primaries starting from strong peri-umbilical tubercles and short weaker intermediate ribs which may be single or may unite to the main ribs in the lower part of the flank. In the adult stage the number of ribs is reduced, costation may be uniform, all ribs are more distant, becoming equal in thickness and prominence. Lateral tubercles are large and sharp but disappear with advanced age.

Discussion: The ornamentation of *Cheloniceras crassum* presents similarities with that of some adult *Cheloniceras cornuelianum* (d’ORBIGNY), showing the same type of radial ribbing. It is possible to collect all the transitional forms between the two species. **CASEY** (1961b, p. 207, text-fig. 63) illustrated a specimen which shows characters of both *Ch. crassum* and *Ch. cornuelianum*. However, typical *Cheloniceras crassum* differ in having a small number of ribs which are stronger and more widely spaced, as well as thicker whorls and a wider umbilicus.

Occurrence: Lower Aptian, upper part of the Deshayesites deshayesi Zone, Paradeshayesites grandis Subzone and base of the Dufrenoyia furcata Zone (Comte Quarry section). This species has been found in the Lower Aptian of SE England, Georgia, Bulgaria and Colombia.

Cheloniceras kiliani

**KOENEN, 1902**

(Pl. 8, fig. 1)

1902 *Cheloniceras kiliani* sp. nov. **KOENEN**, p. 406, Pl. 33, fig. 1.

1961b *Cheloniceras (Cheloniceras) kiliani* (KOENEN); **CASEY**, p. 213, text-fig. 67; Pl. 33, figs. 3-6.

1995 *Cheloniceras kiliani* (KOENEN); **DELANOY**, p. 80, Pl. 4, fig. 2.

2004 *Cheloniceras kiliani kiliani* (KOENEN); **SHARIKADZE et alii**, p. 324, Pl. 11, fig. 1; Pl. 12 fig. 1.

Material: Two complete specimens, PRA-1423, Sc Dw12900, numerous fragments.

Measurements:
Description: Semi-evolute ammonite with rounded venter, wide-oval to sub-octagonal whorl section. Umbilicus width, a quarter of the total diameter. Sculpture consists of alternating thick radial ribs springing from the umbilical wall and weaker inerm intercalary ribs starting from mid flank. Main ribs show strong tubercles on the umbilical margin and on the upper third of the flank. On the young whorls, they can form a two branched fork at the lateral tubercle. Rarely, intermediate ribs may bifurcate, the point of branching being on the upper third of the flank.

Discussion: Like *Cheloniceras crassum*, this species can be confused with *Cheloniceras cornuelianum*. But it differs in its more irregular and less prominent costation, less convex flanks and thinner whorls. Intermediate ribs are less numerous and umbilical tubercles stronger than in the d'ORBIGNY species.

Occurrence: Lower Aptian, Deshayesites *deshayesi* Zone, Comte Quarry section.

Measurements:

| specimen | D     | Wh  | Uw | Wb  | K | Ph | Wb/Wh | morphotype |
|----------|-------|-----|----|-----|---|----|-------|------------|
| PRA1450  | 123.6 | 49.6| 26 | 30  | 25| -  | 0.604 | S/E        |
| C.872    | 97    | 40  | ~24| 27.2| 25| -  | 0.60  | S/E        |
| C.875    | 49    | 26  | ~13| 18  | 22| -  | 0.69  | S/E        |

Description: Our material is very similar to a specimen illustrated by CASEY (1962, text-figure 74, p. 225). Semi-evolute shell with a large umbilicus, rounded venter tending to flatten. On the internal whorls each primary rib springs from a prominent periumbilical tubercle and supports at mid flank a strong lateral spine. Between the main ribs are intercalated two or three thinner inerm ribs. In the adult, the rib-density increases and their aspect changes. Main ribs become thicker and stronger. Lower tubercles are scarcer and tend to disappear. From the last lateral tubercles primary ribs split into two unequal branches: the anterior branch is somewhat weaker than the posterior one. At the end of the phragmocone all ribs become equal and tend to spatulate on the upper part of the flank.

Discussion: To identify our material, we referred to SINZOW (1906: Pl. 1, figs. 7-10) and CASEY’s illustrations (1962: Pl. 36, fig. 4; Pl. 37, figs. 11.a-b; text-figs. 73-a-d). *Cheloniceras meyendorffi* presents some affinities with *Cheloniceras cornuelianum*, which may also have secondary ribs originating from the lateral tubercle but it differs in a more important rib-density and a more distant tuberculation. The holotype, a fragment of shell figured by CASEY (1962, p. 224, text-figs. 73.c-d) was artistically interpreted by d’ORBIGNY, who restored with licence (1845, Pl. 32, figs. 4-5) the missing part of his specimen as was often done at that time.

On the basis of nuclei collected in the Gargasian marls of SE France, DUTOUR (2005) concluded that there were similarities in *Cheloniceras meyendorffi* and *Cheloniceras seminodosum* and united these two taxa in one group. However, there are fundamental differences in the form and the ornamentation of these two species. *Ch. meyendorffi* has an irregular alternation of strong primaries and thicker intermediate ribs, and tubercles on the main ribs are strong and prominent. *Ch. seminodosum* has a more regular sculpture, all ribs become equal in dimensions on the venter, the main ribs bear sharper tubercles, the umbilicus is wider and the ratio Wb/Wh differs notably between the two species. At Cassis-La Bédoule, their ranges are separate: we collected *Ch. seminodosum* in the Deshayes Zone, beds 144 to 169 and *Ch. meyendorffi* in the Furcata Zone, beds 174 – 176.

Occurrence: Lower Aptian, upper part of the Dufrenoyia *furcata* Zone, Comte quarry section.
**Cheloniceras seminodosum**

*(SINZOW, 1906)*

(Pl. 10, figs. 1-4; Pl. 15, figs. 5-6)

1906 *Douvilleiceras seminodosum* sp. nov.

SINZOW, p. 165, Pl. 1, figs. 3 & 6

1910 *Douvilleiceras seminodosum* SINZOW;

KILIAN, p. 340, Pl. 9, fig. 1.

1910 *Douvilleiceras* nov. sp. (aff. *seminodosum*); KILIAN, p. 340, Pl. 9, fig. 2.

1915 *Douvilleiceras seminodosum* SINZOW;

NIKCHITCH, p. 51, Pl. 1, figs. 9a-d; Pl. 2, figs. 1-a-b.

1933 *Douvilleiceras seminodosum* SINZOW;

ROUCHADZE, p. 51, Pl. 3, fig. 1.

1960 *Cheloniceras seminodosum* (SINZOW);

KUDRIAVTSEV, p. 338, Pl. 16, figs. 3.a-b.

1964 *Cheloniceras seminodosum* (SINZOW);

KEMPER, p. 48, Pl. 6, figs. 1.a-b & 2.

1970 *Cheloniceras seminodosum* (SINZOW);

KOTETISHVILI, p. 99, Pl. 19, fig. 4.

1971 *Cheloniceras seminodosum* (SINZOW);

KVANTALIANI, p. 105, Pl. 16, fig. 2; text-figs. 62-63.

2004 *Cheloniceras seminodosum* (SINZOW);

SHARIKADZE et ali, p. 322, Pl. 1, fig. 2; Pl. 3, fig. 2.

2005 *Cheloniceras seminodosum* (SINZOW);

KOTETISHVILI et ali, p. 381, Pl. 92, fig. 3a-b; Pl. 93, figs. 1-3.

non 2005 *Cheloniceras* gr. meyendorffi/seminodosum DUTOUR, p.

156-159, Pl. 19, figs. 7-8.

Material: PRA1450, 5 half whorls, PRA1451, 1452, C.868, C.869, C.882 and numerous fragments.

Measurements:

| specimen  | D   | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|-----------|-----|----|----|----|----|----|-------|------------|
| PRA1450   | 77  | 32 | ~18| 34 | 24 | -  | ~1.06 | S/E        |
| C.861     | 73  | 33 | ~23.5 | 31 (d=50) | 24 | - | ~0.99 | S/E        |
| PRA1451   | 71  | 32 | ~19.2 | 35 | 24 | -  | ~1.09 | S/E        |
| C.868     | ~59 | 21 | ~16 | 10 | 21 | -  | ~0.657 | S/E        |
| C.869     | ~57 | 25 | ~13 | 19 | 22 | -  | ~0.76 | S/E        |
| C.882     | ~40 | 24 | ~11 | 18 | 24 | -  | ~0.75 | S/E        |

Description: Semi-evolute ammonite with rounded whorls increasing rapidly in height and a wide umbilicus. Sculpture consists of 1) radial main ribs starting from the umbilical wall often bifurcating from a lateral tubercle in the upper part of the flank into two equal secondary ribs and 2) two or three intermediate ribs intercalated between two main ribs. All ribs on venter are of uniform relief, broadened and slightly flattened.

Discussion: Our specimen PRA1450 (Pl. 10, fig. 4) is very similar (same number of ribs by half whorl and same general features) to that of figure 4.d, Pl. 1 of SINZOW (1906). It differs only by a more regular costulation and a lesser number of bifurcating main ribs.

Occurrence: Lower Aptian, Deshayesites deshayesi Zone, Comte Quarry section.

Measurements:

| specimen  | D   | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|-----------|-----|----|----|----|----|----|-------|------------|
| C.s102    | 150 | 59.8| 35 | ~40 | 23 | -  | ~0.668 | S/E        |
| C.s103    | 115 | 46 | ~26 | 32 | 22 | -  | ~0.695 | S/E        |

Description: Semi-evolute shell with wide oval to suboctagonal whorl section increasing moderately in height. Umbilicus is about a third of total diameter. Steep umbilical wall. Ornamentation consists of coarse radial primary ribs starting from a strong umbilical tubercle and bearing on the upper third of the flanks a lateral tubercle and intermediate ribs. Main ribs can be single or bifurcated, these form a two branched fork at the lateral tubercle, the anterior branch being stronger than the posterior one. Sometimes intercalary ribs appear at the first third of the flank or at mid-flank. On the venter, all ribs are of equal relief.

Discussion: The two incomplete shells that we describe are bituberculated, but we also collected some fragments which present on the main ribs, as on the holotype and a syntype illustrated by CASEY (1962, p. 220, text-fig. 70; 1980, Pl. CX, fig. 1.a) a kind of elongated node or swelling uniting the umbilical tubercle with the lateral one; this character seems to be a
pecularity of some adult specimens. *Cheloniceras parinodum* presents similarities with *Cheloniceras cornuelianum*, but differs in a narrower and shallower umbilicus, a smaller number of ribs, and a coarser sculpture.

Occurrence: Lower Aptian, *Deshayesites deshayesi* Zone (Paradeshayesites grandis Subzone) and lowermost part of the *Dufrenoyia furcata* Zone, Comte Quarry section.

**Cheloniceras disparile**

CASEY, 1961

(Pl. 9, fig. 2)

1961b *Cheloniceras (Cheloniceras) disparile* sp. nov. CASEY, p. 215, Pl. 34, figs. 7.a-b & 8.a-c; text-figs. 67.g & 68.

2004 *Cheloniceras (Cheloniceras) disparile* CASEY; SHARIKADZE et ali, p. 319-320, Pl. 24, fig. 2.

Material: One specimen - PRA1452, Lower Aptian

Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|--------|------------|
| PRA1452  | 33.8 | 25  | 13.5 | 15  | 24 | -  | 0.6    | S/E        |

Description: Small semi-evolute ammonite with rounded whorls increasing moderately in height, a deep umbilicus, an abrupt wall and robust costation. Sculpture consists of main ribs of various thicknesses, starting from the umbilical tubercle or from the umbilical wall and bifurcating at mid-flank from a lateral tubercle, the anterior branch being stronger than the posterior one. One or two thinner non tuberculate intermediary ribs, starting from mid-flank or from the umbilical border, are intercalated between the primary ribs.

Discussion: This rare species has similarities with *Cheloniceras cornuelianum* (d’ORBIGNY), from which it is transitional toward the genus *Epicheloniceras*. According to CASEY (1961b, p. 215), it has a similar suture-line. The poor preservation of our specimen made it impossible to verify this fact and for this reason, we maintain its original status. It differs from the species of d’ORBIGNY in having unequal ribs (the branches of bifurcation are of unequal strength), narrower and less depressed whorls.

Occurrence: We collected this form at the top of the *Deshayesites dehayesi* Zone (Paradeshayesites grandis Subzone) in the Comte quarry section.

**Cheloniceras quadrarium**

CASEY, 1962

(Pl. 11, fig. 1.a-b)

1962 *Cheloniceras (Cheloniceras) quadrarium* sp. nov. CASEY, p. 227-229, Pl. 36, fig. 7; Pl. 37, fig. 10; text-figs. 76 & 77 a-f.

2004 *Cheloniceras (Cheloniceras) quadrarium* quadrarium CASEY; SHARIKADZE et ali, p. 332-333; Pl. 8, fig. 2; Pl. 9, fig. 1; Pl. 10, fig. 1.

Material: A poorly preserved half specimen: C.873

Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|--------|------------|
| C.873    | 270 | 83 | ~52 | ~76 | ~24 | -  | ~0.915 | S/E        |

Description: Large and compressed semi-evolute specimen with very inflated whorls. On the external whorl costation consists of radial rounded main and intercalary ribs separated by narrow interspaces. On the young whorl robust main ribs are bituberculated, each rib bearing a strong umbilical tubercle and a lateral one. Some main ribs can divide into two narrow branches starting from the lateral tubercle. General pattern and inner whorl are similar to the form illustrated in CASEY (1962, p. 228, text-fig. 76).

Discussion: This species, rare in SE France, has narrower and less strongly developed tubercles than *Cheloniceras seminodosum* SINZOW, *Cheloniceras (Cheloniceras) disparile* CASEY, and *Cheloniceras cornuelianum* d’ORBIGNY. It differs also from these species in its very inflated whorls and wider umbilicus.

Occurrence: *Deshayesites deshayesi* Zone (upper part of the Paradeshayesites grandis Subzone), Comte quarry section.

**Cheloniceras mackesoni**

CASEY, 1962

(Pl. 12, fig. 1; Pl. 13, fig. 1)

1962 *Cheloniceras (Cheloniceras) mackesoni* sp. nov. CASEY, p. 231-234, Pl. 36, figs. 1 & 2.a-b; text-figs. 78, 79.a & 80.

1968 *Cheloniceras aff. mackesoni* CASEY; KEMPER, p. 72, Taf. 25, fig. 4.

Material: Seven specimens: PRA1451, PRA1452, PRA1463, PRA1464, PRA1467, PRA1470, C.475 and five pieces of whorls.
Measurements:

| specimen | D     | Wh   | Uw | Wb | K | Ph | Wb/Wh | morphotype |
|----------|-------|------|----|----|---|----|-------|------------|
| PRA1451  | 355.5 | 150  | 94 | 109| 35| -  | 0.72  | S/E        |
| PRA1452  | 410   | 158  | 131| 131| 37| -  | 0.829 | S/E        |
| PRA1453  | 428   | 160  | 120| 137.5|38| d=350| 0.859 | S/E        |
| PRA1454  | 350   | 146  | 50 | 105.8|38| d=97.5| 0.735 | S/E        |
| PRA1457  | 210   | 80   | 58 | 65.60|35| -  | 0.820 | S/E        |
| PRA1470  | 170   | 54   | 47 | 44.49|34| d=75 | 0.823 | S/E        |
| C.475    | 150   | 52   | 40 | 45  | 35| -  | 0.885 | S/E        |

Description: Large semi-evolute shells (some specimens approach 400 mm in diameter), whorls increasing moderately in height, suboctagonal to rounded whorl section. Costation consists of primary rounded ribs connected to the umbilical tubercle and in one, two or three intercalary ribs, irregularly distributed, some starting at mid-flank, others tending to bunch and in general joining the main ribs at the umbilical border. Umbilical tubercle is prominent and can form a sort of bulla. Lateral tubercles are feeble (some traces at mid-flank) and are completely absent on adult whorls. Main ribs are particularly prominent on venter and pass straight on the other side.

Discussion: Our material was determined by CASEY (personal communication, 1997). It is very similar to the typical forms figured by this author (1962, Pl. 36, figs. 1 & 2.a-b; text-fig. 78). This species presents relatively compressed whorls and cannot be confused with another taxon. It differs from other Cheloniceras in its ribbing which resembles that of Parahoplites, with umbilical nodes on the inner whorls which become discrete tubercles on the adult and then tend toward absence on the last whorl.

Occurrence: Deshayesites deshayesi Zone (Paradeshayesites grandis Subzone), Comte quarry section.

Measurements:

| specimen | D     | Wh   | Uw | Wb | K | Ph | Wb/Wh | morphotype |
|----------|-------|------|----|----|---|----|-------|------------|
| PRA1456  | 133.4 | 48   | 30 | 64 | 27| 94 | 1.33  | S/E        |
| C.876    | 62.3  | 32   | -  | 39.4| 21| -  | 1.23  | S/E        |
| C.874    | 55    | 20   | 11.2| 22 | 25| -  | 1.1   | S/E        |
| PRA1457  | 23    | 6.2  | 7  | 15 | 25| -  | 1.62  | S/E        |
| PRA1458  | 21    | 8.2  | 5.2| 14  |25| -  | 1.7  | S/E        |
| C.877    | 19    | 6.2  | 5  | 14.2| 24| -  | 2.25  | S/E        |
| C.878    | 19    | 7    | 5  | 12.2| 22| -  | 1.74  | S/E        |

Description: Adult specimens are semi-evolute shells with rounded whorls increasing moderately in height, but three stages of growth can be observed:

- an initial stage, or "royerianum" stage. As observed and figured by DUTOUR (2005: p. 154-155, Pl. 19, figs. 3.b & 3.e), and already hinted at but not convincingly demonstrated by NIKCHITCH (1915) and CASEY (1961b), the initial whorls of Cheloniceras cornuelianum are similar to the figuration of "Ammonites royerianus" d'ORBIGNY 1841 (Pl. 112, figs. 3-5). This stage is characterized by a very depressed subtrapezoidal section, flat whorls with strong lateral spinose tubercles and a deep crateriform umbilicus. Ornamentation consists of spaced ribs forming a twofold constriction. Between them the venter is smooth, without intercalary ribs. This morphologic stage can be also found in the young whorls of Epicheloniceras martini.
• an intermediary stage, showing, on a slightly rounded venter, the characteristic sculpture of *Cheloniceras cornuelianum*: main tuberculate ribs with two pairs of tubercles, followed by two smooth intercalary ribs.

• an adult stage: the section become rounded-subrectangular. The venter is now convex, the lateral tubercles are smaller and tend toward absence on the last whorl, the umbilical tubercles become stronger and more widely spaced. Main ribs bifurcate on the flanks, at different height; generally two branches originate from the lateral tubercle, but sometimes they can start from the umbilical one.

Discussion: We collected large specimens, generally in calcareous beds, that we considered macroconches, and small pyritized nuclei in marls. *Cheloniceras cornuelianum* seems to be a highly variable taxon. S HARIKADZE (2004) distinguished two groups in this species:

• one group with 38-48 thin ribs on one whorl, wide trapezoidal whorl section, flattened venter.

• a second group with a small number of thick ribs and a wide-oval whorl section with a rounded venter.

The problem is to know whether it is convenient to add a third, that would comprise the forms transitional to the genus *Epicheloniceras* (Fig. 9) which include the specimens similar in form and sculpture to *Cheloniceras cornuelianum*, but with incipient feeble ventral tubercles on the ventral part.

**Figure 9:** (from left to right): evolution of *Cheloniceras cornuelianum* towards *Epicheloniceras*. a) *Cheloniceras royrianum* (lowermost *Dufrenoyia furcata* Zone); b-d) *Cheloniceras cornuelianum* (*Dufrenoyia furcata* Zone); e-f) transitional forms to the genus *Epicheloniceras* and appearance of ventral tubercles = *Epicheloniceras martini* "ex-gr. occidentalis" (Jacobs) (lowermost *Epicheloniceras martini* Zone); g) *Epicheloniceras martini martini* (d’Orbigny) = *Epicheloniceras martini* ex-gr. "orientalis" (Jacobs) (Epicheloniceras martini Zone) [Photographs A. Arnoux].

**Occurrence:** *Deshayesites deshayesi* Zone (Paradeshayesites grandis Subzone), *Dufrenoyia furcata* Zone, Comte Quarry section; *Epicheloniceras martini* Zone (base of the *Epicheloniceras debile* Subzone), La Marcouline section.

**Cheloniceras minimum**

**CASEY, 1962**

(Pl. 15, fig. 4)

1961a *Cheloniceras* (Cheloniceras) sp. nov. CASEY, p. 609.

1962 *Cheloniceras* (Cheloniceras) minimum CASEY, p. 217, Pl. XXXV, figs. 5.a-c.

Material: one specimen: C.878

**Measurements:**

| specimen | D  | Wh | lw | Wh | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|--------|------------|
| C.878    | 24.8 | 22 | -  | 23 | 30 | -  | 1.04   | 1          |

Description: Rare small shell, with wide venter, subquadratate whorls in section. On mid-flank small lateral tubercles. Ornamentation consists of primary ribs often bifurcating on the first third of flanks, and thin intercalaries which either extend to the umbilical border or disappear on flanks. Ribbing tends to become very uniform and sharp so primary ribs cannot be distinguished from secondaries.

Discussion: We collected *Cheloniceras minimum* at the base of the *Dufrenoyia furcata* Zone. The specimens of CASEY (1962) come from the *Deshayesites deshayesi* Zone, *Paradeshayesites grandis* Subzone.

Occurrence: extreme base of the *Dufrenoyia furcata* Zone, Comte quarry section.
Genus Epicheloniceras
CASEY, 1954

Type species: Douvilleiceras tschernyschewi
SINZOW (1906, p. 182, Pl. 2, fig. 11).

Diagnosis: Semi-evolute shell with very inflated whorls, wide umbilicus, oval whorl section. The venter is rounded, flattened, or broad, and can show thin intermediate ribs. Sometimes on the last whorl, all ribs are equal.

Three principal characters differentiate Epicheloniceras from Cheloniceras:

- the presence of three pairs of tubercles: ventro-lateral, lateral and umbilical,
- a mid-ventral depression on the ribs,
- main ribs bifurcating in two unequal or independent branches from the lateral tubercle.

These characters often disappear during ontogeny, and as a result adult or mature specimens may show a Cheloniceras-like morphologic pattern, particularly when they attain a large size; the ventro-lateral tubercles decrease progressively in prominence, shrink and finally disappear. Some Epicheloniceras, like E. martini, conserve a "Cheloniceras royerianum" stage in the initial whorls. From the strata transitional from the Furcata to the Martini Zone we collected all the forms transitional from the Furcata to the Martini Zone. This lineage is characterized mainly by the presence of a very isocostated stage starting with the first whorls;

- the lineage Cheloniceras cornuelianum/Cheloniceras crassum, leading to Epicheloniceras martini with a commonly well developed "royerianum" stage, without ribbing between the very widely spaced main ribs or contractions. This "royerianum" stage is clearly visible on his figures (op. cit., Pl. 19, figs. 3.b & d-e, for Cheloniceras cornuelianum and Pl. 25, figs. 1.b, d, f, h & 2.a-b & d-g for Epicheloniceras martini).

At Cassis-La Bédoule we too have followed, bed by bed, this progressive evolutionary process, for which we intend to discuss the possible taxonomic repercussions more thoroughly elsewhere. In this biostratigraphic paper, we will continue provisionally to consider Epicheloniceras a generic taxon.

**Epicheloniceras martini**
(d’ORBIGNY, 1841)

1841 Ammonites Martini d’ORBIGNY, p. 194, Pl. 58, figs. 7-8, non fig. 9.
1905 Douvilleiceras Martini d’ORBIGNY sp. var. orientalis JACOB, p. 412.
1960 Epicheloniceras martini caucasica KUDRIAVTSEV, p. 339, Pl. XX, figs. 2.a-b.
1960 Epicheloniceras martini orientalis (JACOB); KUDRIAVTSEV, p. 340, Pl. XXI, figs. 2.a-b.
1961a Cheloniceras (Epicheloniceras) martinoides CASEY, p. 595, Pl. 84, fig. 2; text-figs. 14.d-e.
1962 Cheloniceras (Epicheloniceras) martinoides CASEY; CASEY, p. 239, Pl. XXXVII, figs. 1.a-c & 2; Pl. XXXVIII, figs. 3.a-b; Pl. XXXIX, fig. 2; text-figs. 83 & 86.g-h.
1962 Cheloniceras (Epicheloniceras) cantianum CASEY, p. 242, Pl. XXXIX, figs. 10.a-b.
2005 Cheloniceras martini (d’ORBIGNY); DUTOUR, p. 163-170, Pl. 20, figs. 1-4; Pl. 21, fig. 1; Pl. 22, figs. 1-2; Pl. 23, fig. 1; Pl. 24, figs. 1-6; Pl. 25, figs. 1-8 & 12.
2005 Epicheloniceras martini (d’ORBIGNY); KOTETISHVILI et alii, p. 384, figs. 2.a-b.

**morphotype martini**
ex group "occidentalis"
(JACOB, 1905)

(Figs. 10 & 11.c-d)

Material: 7 pyritic specimens: n° PRAG 1457, PRAG 1458, PRAG 1496, PRAG 1497, PRAG 1498, PRAG 1499, PRAG 1500, 5 calcareous shells: CG822, CG826, CG827, CG828, CG831 and numerous fragments of whorls.
Measurements: Pyritic specimens

| specimen | D   | Wh  | Uw | Wb  | K  | Ph | Wb/Wh | morphotype |
|----------|-----|-----|----|-----|----|----|-------|------------|
| PRAG 1499 | 24.5 | ~10.5 | 8  | 15  | 23 | -  | 1.42  | S/E        |
| PRAG 1457 | 21.2 | 7.6  | 7.8 | 18  | 22 | -  | 2.36  | S/E        |
| PRAG 1458 | 20  | 8    | 8   | 14.9 | 22 | -  | 1.86  | S/E        |
| PRAG 1496 | 15  | 7.9  | 5   | 12  | 22 | -  | 1.51  | S/E        |
| PRAG 1497 | 12  | 5    | 3.5 | 9   | 15 | -  | 1.5   | S/E        |
| PRAG 1458 | 11  | 4.5  | 3.2 | 6.5 | 8  | -  | 1.44  | S/E        |
| PRAG 1500 | 15  | 7.8  | 4.6 | 13  | 18 | -  | 1.66  | S/E        |

* E. martini morphotype "occidentalis", "royerianum" stage

Measurements: Calcareous specimens

| specimen | D   | Wh  | Uw | Wb  | K  | Ph | Wb/Wh | morphotype |
|----------|-----|-----|----|-----|----|----|-------|------------|
| CG832    | ~26 | ~12 | -  | ~18.2 | 20 | -  | ~1.51 | S/E        |
| CG927    | ~24 | 10.2 | -  | ~10  | 22 | -  | ~1.75 | S/E        |
| CG922    | ~22.5 | ~7.9 | -  | ~18 | 22 | -  | ~2.27 | S/E        |
| CG926    | ~22 | ~7.2 | -  | ~14.2 | 15 | -  | ~1.37 | S/E        |
| CG931    | 19  | 8   | 5.8 | 6 with d=17.5 | 19 | -  | ~0.75 | S/E        |

Description: Similar in form and ribbing to Cheloniceras cornuelianum, with a "royerianum" stage in initial whorls. Spaced ribs forming a twofold constriction ended by a strong and sharp lateral tubercle. One two or three non tuberculate intermediate ribs are intercalated between the main ribs. Then, on the primaries slightly depressed at mid-venter, appear two feeble ventro-lateral tubercules. The venter is flat or slightly convex, the umbilicus rather wide and deep.

Discussion: For the first time JACOB (1905, p. 412-413) distinguished two varieties of Epicheloniceras martini (d'ORBIGNY): E. martini var. "occidentalis" and E. martini var. "orientalis", each, according to the author, restricted to a discrete geographic area.

- The first variety is a form with a sub-hexagonal whorl section, a convex venter on which the primaries are bounded at each end by a conical spinose tubercle and which support two feeble ventro-lateral tubercles. This variety is characteristic of the "faciès occidental" (Kilian, 1895, p. 762-765; Jacob, 1905) and occurs mainly at Gargas, Carniol and in the Apt region.
- The second variety has a stronger sculpture and a more rounded venter and is represented only by forms like those of figs. 7 and 8, Pl. 58 in d'Orbigny (1841); it can be collected in the "faciès oriental" (Kilian, 1895, 765-770), that is to say in the Voucontian Basin (Sisteron, Hyèges, Vergons, Barrême, Drôme region).

Figure 10: Characterization of several stages in a transitional form of Epicheloniceras martini [Photographs A. ARNOUX].
Figure 11: *Ammonites martini d’ORBIGNY* in "*Paléontologie française*" (1841), Pl. 58, figs. 7-8.

Figure 12: Scheme showing (at La Marcouline Quarry section, within the Debile Subzone) the progressive evolution from “*Cheloniceras cornuelianum*” to “*Epicheloniceras martini martini*”. a1, a2) *Cheloniceras cornuelianum* – b) *Cheloniceras cornuelianum* “royerianum” stage - c) *Epicheloniceras martini* morphotype ex group “occidentalis” - d) *Epicheloniceras martini* “royerianum” stage - e) *Epicheloniceras martini* morphotype “martinioides” - f, g1, g2) *Epicheloniceras martini martini* (ex group “orientalis”).
This proposal was based on an erroneous concept and led to numerous stratigraphic ambiguities and misinterpretations. In fact, these varieties are not synchronous and constitute successive steps in the evolution of *Epicheloniceras martini*. At Cassis-La Bédoule we collected *Epicheloniceras martini* morphotype "occidentalis" at the base of the *Epicheloniceras martini* Zone and the morphotype "orientalis" at the top of the *Epicheloniceras debile* Subzone.

Occurrence: *Epicheloniceras martini* Zone, *Epicheloniceras debile* Subzone (beds M-6 to M-10). La Marcouline Quarry section.

Measurements (Pyritic specimens):

| specimen | D   | Wh  | Uw  | Wb  | K   | Ph | Wb/Wh | morphotype |
|----------|-----|-----|-----|-----|-----|----|-------|------------|
| PRAG 1512 | 38.5 | 1.5 | 10  | 24  | 18  | -  | 1.57  | E          |
| PRAG 1513 | 15  | 3.0 | 5   | 12  | 18  | -  | 1.36  | E          |
| PRAG 1514 | 18  | 8.5 | 4.5 | 10  | 18  | -  | 1.17  | E          |

Measurements (Calcareous specimens):

| specimen | D   | Wh  | Uw  | Wb  | K   | Ph | Wb/Wh | morphotype |
|----------|-----|-----|-----|-----|-----|----|-------|------------|
| CG825   | 28.5| 1.1 | 8   | 18  | 20  | -  | 1.63  | E          |
| CG925   | 26.2| 5.2 | 6.3 | 12  | 18  | -  | 1.50  | E          |
| CG926   | 15.5| 3.5 | 4   | 10  | 18  | -  | 1.42  | E          |

Description: Semi-evolute shell with very inflated whorls, wide umbilicus, about 40 per cent of total diameter, oval whorl section. The costulation consists of radial robust primaries and one, two or three thinner secondary ribs. Strong lateral and ventro-lateral tubercles.

Discussion: Differs from the morphotype "occidentalis" in having in immature whorls some similarities with *Epicheloniceras tschernyschewi* (Sinzow). It is difficult to separate microconchs of these forms.

Occurrence: *Epicheloniceras martini* Zone, *Epicheloniceras debile* Subzone (beds M-22 to M-30), La Marcouline Quarry section.

**Figure 13:** a-c: *Epicheloniceras martini* "orientalis" Jacob, in KUDRIAVTSEV 1960, Pl. XXI, figs. 2.a-c (venter still flat and wide as in *Cheloniceras cornuelianum*) – 1-4: *Epicheloniceras martini* (d’Orbigny), four views of the same specimen, La Marcouline Quarry section (venter rounded; this is the final stage of *E. martini*).
**morphtype martinioides**  
CASEY, 1961

(Fig. 11.e; Pl. 16, figs. 2 & 9)

Measurements:

| Specimen | D  | Wh | Uw | Wb  | K  | Ph | Wb/Wh | Morphotype |
|----------|----|----|----|-----|----|----|-------|------------|
| CG911    | 65 | 26 | 15.5 | 24.8 | 26 (D=62) | d=50 | 0.95 | S/E       |
| CG912    | 48 | 20 | 16  | 29  | 23 | d=38 | 1.45 | S/E       |
| CG913    | 39 | 15 (14, d=35) | 9 | 21 (D=35) | 24 | d=27 | 1.4 | S/E       |

Description: Similar in form and sculpture to *Epicheloniceras martini* but with stronger ventral and lateral tubercles and only one or two intermediate ribs. The young stage of this form (before D = about 40mm) can be confused with *Epicheloniceras tschernyschewi* (SINZOW). Mature specimens can be distinguished from the species of SINZOW by fewer secondary ribs and a more important whorl width.

Discussion: CASEY (1962, p. 241) did not find the types of *Epicheloniceras martini* in the collections of d'ORBIGNY in the Museum National d'Histoire Naturelle of Paris. As a result he erected a new species on the basis of specimens from the Lower Greensands of the Isle of Wight.

The group of *Epicheloniceras martini* shows a great variability. *Epicheloniceras martinioides* appears to be only a variety within this group, along with the conspecific "orientalis", "occidentalis", "cantianum" or "alternatum" morphotypes. In agreement with DUTOUR (2005, p. 164) we think that it is not necessary to separate the *martinioides* form as a species distinct from that of d'ORBIGNY.

Occurrence: Middle Aptian (Gargasian) *Epicheloniceras martini* Zone, Epicheloniceras debile Subzone (beds M-7 to M-10, La Marcouline Quarry section).

**Epicheloniceras eotypicum**  
CASEY, 1962

(Pl. 21, figs. 3 & 7-8)

1962 *Cheloniceras (Epicheloniceras) eotypicum* CASEY, p. 243, Pl. XXXVIII, figs. 4a-d; Pl. XXXIX, figs. 5a-b; text-fig. 86f.

2005 *Cheloniceras (Epicheloniceras) eotypicum* CASEY; DUTOUR, p. 182-184, Pl. 28, figs. 1-5.

Material: 3 specimens (PRAG 2017, PRAG 2018, PRAG 2015).

Measurements:

| Specimen | D  | Wh | Uw | Wb  | K  | Ph | Wb/Wh | Morphotype |
|----------|----|----|----|-----|----|----|-------|------------|
| PRAG 2017 | 60 | 25.5 | 13.5 | 20  | 20 | -  | 0.78  | E          |
| PRAG 2010 | 37 | 16 | 12  | 11  | 13 | -  | 0.66  | E          |
| PRAG 2015 | 31 | 13.8 | 8.8 | 15  | 20 | -  | 1.08  | E          |

Description: Evolute shell with a suboctagonal whorl section, rounded venter, wide umbilicus (about one third of the diameter). Sides are flat or gently convex. Ribbing consists of main ribs taking their origin from a vertical umbilical wall and of one or two intercalary ribs starting irregularly from the umbilical wall or from mid-flank. The primaries, often flattened on the flank, bear a feeble lateral tubercle at the first third of flank and from D=50 mm, a feeble ventro-lateral thorn-like spine. All the ribs run straight on the venter and show an adoral convexity.

Discussion: According to CASEY (1962, p. 244), juvenile specimens of *Epicheloniceras eotypicum* cannot be separated from the form "Cheloniceras" until they attain a relatively late stage of growth.

Occurrence: Middle Aptian (Gargasian) *Epicheloniceras martini* Zone, upper part of the *Epicheloniceras debile* Subzone, La Marcouline Quarry section.

**Epicheloniceras debile**  
CASEY, 1961

(Pl. 17, figs. 1.a-b & 2)

1961a *Cheloniceras (Epicheloniceras) debile* CASEY, p. 595, Pl. 84, figs. 3.a-b; text-fig. 14.b.

1962 *Cheloniceras (Epicheloniceras) debile* CASEY; CASEY, p. 244, Pl. XXXVII, figs. 3-7, text-figs. 85-86.b.

2004 *Epicheloniceras debile* CASEY; SHARIKADZE et alii, p. 357, Pl. 45, fig. 2.

2005 *Epicheloniceras debile* CASEY; DUTOUR, p. 175-177, Pl. 26, figs. 1-5; Pl. 27, figs. 6-9.

Material: 4 complete specimens: PRAG 1476, 1475, 1482, 1491 and 5 pieces of whorls.
Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|-------|------------|
| PRAG 1482 | 134 | 57 | 36.5 | 43.2 | 20 | d=114 | 0.75 | E          |
| PRAG 1476 | 63.2 | 23 | 15 | 17 | 18 | -   | 0.73 | E          |
| PRAG 1475 | 21.6 | 6.5 | 5 | 12.5 | 22 | -   | 1.47 | S/E        |
| PRAG 1491 | 15.6 | 5.8 | 4.8 | 9.7 | 22 | -   | 1.67 | S/E        |

Description: Evolute to semi-evolute shell with a wide-oval cross section in the young stage and a polygonal whorl section in the later stage. Venter is convex with a ventral sulcus between two rows of ventro-lateral tubercles, which as ontogeny progresses first become rounded nodes and then tend to disappear in the adult. Ornamentation consists of an irregular alternation of main ribs starting from sharp umbilical tubercles on the umbilical margin and of one to three thinner intermediate ribs. Main ribs bear at mid-flank radially elongated lateral tubercles. Interspace between primary and secondary ribs differs and each rib can be radial or slightly inclined forward.

Discussion: In spite of some similarities with *Epicheloniceras tschernyschewi* in the young, this taxon differs notably from the species of *SINZOW* (1906) in its irregular ribbing, thinner whorls, wider umbilicus, and the reduction of ventro-lateral tubercles. With growth, the flanks become higher and slightly flattened. *E. debile* differs from the *E. martini* morphotype *martinoides* in having more intermediate ribs, and more depressed and thinner whorls.

Occurrence: Middle Aptian (Gargasian) *Epicheloniceras martini* Zone, *Epicheloniceras debile* Subzone, La Marcouline Quarry section.

* Crushed specimens

Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|-------|------------|
| PRAG 1477* | 54 | 28 | 15.6 | 17 | 15 | -   | 0.65 | S/E        |
| PRAG 1479 | 52 | 24 | 13 | 18 | 16 | -   | 0.75 | S/E        |
| PRAG 13915* | 42 | 19.8 | 10 | ~17 | 12 | -   | 0.85 | S/E        |
| PRAG 1478 | 38 | 15 | 9 | 18 | 15 | -   | 1.12 | S/E        |
| CG 4 | 33 | 15.5 | 8 | ~17 | 15 | -   | 1.25 | S/E        |
| PRAG 2130 | 30 | 11 | 7.8 | 13 | 15 | -   | 1.18 | S/E        |
| CG 7 | 30 | 12 | ~7.5 | ~12.8 | 15 | - | 1.06 | S/E        |
| CG 8 | 29.4 | 12 | ~7.2 | 13 | 15 | - | 1.08 | S/E        |
| CG 9 | 28.2 | 12 | ~7 | ~12.5 | 16 | - | 1.04 | S/E        |
| CG 8* | 25.6 | 12.5 | ~7 | ~12 | 14 | - | 0.96 | S/E        |
| PRAG 2131 | 26 | 10 | 7.5 | 13.8 | 15 | - | 1.38 | S/E        |
| PRAG 2132 | 20 | 9.8 | 6 | 11 | 15 | - | 1.12 | S/E        |

* Crushed specimens

Description: Evolute to semi-evolute shell with whorls strongly inflated, wide and octagonal whorl section. Ornamentation consists of strong trituberculate primary ribs and of one or two intermediate ribs between the main ribs. In the mature stage of growth the intermediate ribs may disappear. Thorn-like umbilical tubercles are situated at the umbilical margin. They can be radially elongated in the direction of the ribs in the adult. In the middle of the flanks are strong, sometimes flattened lateral tubercles which decrease as growth proceeds. External tubercles on the ventro-lateral area are prominent in early stages but then are more weakly salient.

* *Epicheloniceras subnodosocostatum* *(SINZOW, 1906)*

1906 *Douvilleiceras subnodosocostatum* *SINZOW*, p. 175, PI. II, figs. 1-8.
1915 *Douvilleiceras subnodoso-costatum* *SINZOW*; *NIKCHITCH*, p. 40-45 & p. 53, PI. VI, figs. 4-7.
1960 *Epicheloniceras subnodoso-costatum* *(SINZOW)*; *KUDRIAVTSEV*, p. 342, PI. XXII, figs. 4.a-b.
1962 *Cheloniceras* *(Epicheloniceras)* *sellindgense* var. *audax* *CASEY*, p. 253, PI. XXXVII, figs. 8.a-b; text-fig. 86.d.
1964 *Cheloniceras subnodosocostatum* *(SINZOW)*; *KEMPER*, p. 51, PI. 8, figs. 1.a-b & 2.a-b.
1997 *Cheloniceras subnodosocostatum* *(SINZOW)*; *IMMEL et alii*, p. 180, fig. 2.
2005 *Epicheloniceras* *tschernyschewi* [=*Cheloniceras subnodosocostatum* *(SINZOW)]*; *DUTOIR*, p. 170-173.
2005 *Epicheloniceras subnodosocostatum* *(SINZOW)*; *KOTETISHVILI et alii*, p. 383, PI. 93, figs. 6.a-b; PI. 95, figs. 1.a-b.

Material: 12 complete specimens: PRAG 1477, PRAG 13915, PRAG 1479, PRAG 2130, PRAG 2131, PRAG 2132 CG4, CG6, CG7, CG8, CG9, and 7 half whors.
Figure 14: Typical pyritized specimens of *Epicheloniceras subnodosocostatum* (Sinzow, 1906), La Marcouline Quarry section - a-b) macroconch form, right side and ventral view; c, d) microconch form.

Discussion: *Epicheloniceras subnodosocostatum* differs in shape and sculpture from *Epicheloniceras tschernyschewi* (Sinzow) in having less numerous intermediary ribs, a whorl section which increase more rapidly in height and in more flattened flanks. In contrast with *E. martini* (d’Orbigny), *E. subnodosocostatum* is characterized by a greater inflation of the last whorl and an absence of sulcus on the ventral area between the ventro-lateral tubercles.

Occurrence: Middle Aptian (Gargasian); *Epicheloniceras martini* Zone, La Marcouline Quarry section.

**Epicheloniceras gracile**

CASEY, 1961

(Pl. 19, figs. 1.a-b; Pl. 21, fig. 1)

1961a *Cheloniceras (Epicheloniceras) gracile* CASEY, p. 596, Pl. 81, figs. 1.a-b; text-fig. 14.c.

1962 *Cheloniceras (Epicheloniceras) gracile* CASEY; CASEY, p. 250, Pl. XXXVIII, figs. 2.a-b; Pl. XXXIX, figs. 1.a-b; text-fig. 86a.

2005 *Epicheloniceras gracile*, CASEY; DUTOUR, p. 178-180, Pl. 27, figs. 1-5.

Material: 5 specimens PRAG 1490, CG972, CG965, CG465, CG966, 1 incomplete specimen: labeled D10, DEROGNAT Collection, 1 half whorl: CG914, numerous fragments of whorls.

Measurements:

| specimen   | D   | Wh  | Uw  | Wb  | K   | Ph | Wb/Wh | morphotype |
|------------|-----|-----|-----|-----|-----|----|-------|------------|
| D10        | 157 | 67  | 35.2| 36.4| 35  | -  | 0.54  | S/E        |
| FRAG 1490  | 154.2| 62.3| 37  | 44.5| 28  | d=118| 0.71  | S/E        |
| CG914      | ~137| 65  | 30  | 41.2| 39  | -  | 0.94  | S/E        |
| CG972      | ~98 | 43.5| ~24 | 22  | 28  | -  | 0.50  | S/E        |
| CG965      | 63  | 22.5| 16.5| ~17 | 30  | -  | 0.75  | S/E        |
| CG465      | 30  | 17  | 9   | ~11 | 30  | -  | 0.64  | S/E        |
| CG966      | 22  | 6.5 | 5   | ~6  | 25  | -  | 0.70  | S/E        |

Description: Semi-evolute ammonite with a coronatiform whorl section. From an early *tschernyschewi* stage on the nucleus, the shell evolves progressively to a martinioides stage, with umbilical, lateral and ventro-lateral tubercles and only one or two intermediate ribs between the main ribs. Then the costulation becomes denser with primaries irregularly distributed, being more prominent on the venter. In the adult, at very large diameters all ribs tend to be equal and flattened, some starting from the umbilical tubercle, other from the mid-flank. Lateral and ventro-lateral tubercles disappear. The venter is rounded, the umbilicus rather wide and deep.

Discussion: Our specimens differ from the lectotype in having a coarser and sharper sculpture, fewer and more distant ribs, and a wider umbilicus. They show close similarities with the variety "rugatum" CASEY, 1962, but they retain the three typical *tschernyschewi*, *martinioides* and *gracile* growth stages of the CASEY’s species, and show no similarity with *Cheloniceras* aff. *meyendorffi* (Kazansky, 1914) as that English author has already pointed out.

Occurrence: Middle Aptian (Gargasian); *Epicheloniceras martini* Zone, *Epicheloniceras gracile* Subzone, La Marcouline Quarry section.
Epicheloniceras buxtorfi (JACOB & TOBLER, 1906)

(Pl. 18, fig. 2; Pl. 21, fig. 2)

1906 Douvilleiceras Buxtorfi JACOB & TOBLER, p. 15, PI. 1, figs. 9-11.
1915 Douvilleiceras Buxtorfi JACOB & TOBLER; NIKICHICH, p. 45-47 & 53, PI. VI, figs. 8-10.
1962 Cheloniceras (Epicheloniceras) buxtorfi (JACOB & TOBLER); CASEY, p. 253, PI. XXXIX, figs. 8.a-b; text-figs. 88.1-p.

Measurements:

| specimen | D   | Wh  | Thw | Wb  | K   | Ph  | Wb/Wh | morphotype |
|----------|-----|-----|-----|-----|-----|-----|-------|------------|
| PRAG 1510 | 51.5 | 28  | 15  | ~17 | 16  | -   | 0.60  | S/E        |
| PRAG 2011 | 40.0 | 21.2| 12.5| 26  | 16  | -   | 1.22  | S/E        |

Description: Semi-evolute shell moderately increasing in height with a coronatiform wide-oval to subrectangular whorl section. Venter slightly convex becoming flat at the end of the first whorl. The sculpture consists of strong radial primary and one, rarely two, intermediary ribs. All ribs are separated by wide concave interspaces. On the ventral area, all ribs are feebly arcuate forward. From a lateral conical tubercle, main ribs can sometimes bifurcate at mid-flank into two unequal branches. Strong ventro-lateral tubercles. In the mature stage the costulation simplifies and resembles that of Epicheloniceras subnodosocostatum. On the body-chamber, ribs in uniform relief are unbranched.

Discussion: DUTOUR (2005) described and illustrated pyritized nuclei of Epicheloniceras buxtorfi and E. subnodosocostatum. Because of morphological similarities between the two species, the author considered them as conspecific. The first was thought to be the microconch, the second the macroconch of the conspecific. The first was thought to be the species, the author considered them as morphological similarities between the two Epicheloniceras buxtorfi. This hypothesis is undoubtedly of great interest, but given the present state of our knowledge, great care must be taken to determine whether or not true dimorphism exists. To accept the dimorphism of taxa previously thought to be discrete, it is necessary to collect them in the same stratigraphic level, or even in the same bed. Unfortunately, it seems that the range of E. subnodosocostatum differs from that of E. buxtorfi. At Cassis-La Bédoule we collected E. subnodosocostatum from beds 12 to 44 in the lower part of the Gargasian (E. debile and gracile subzones), and E. buxtorfi from beds 51 to 54, in a level just under the Parahoplites melchioris Zone and that stratigraphically is equivalent of the E. buxtorfi Subzone of CASEY (1961a).

Moreover there are morphologic dissimilarities between the two taxa. E. buxtorfi differs from E. subnodosocostatum in having a smaller number of intercalary ribs, a weaker sculpture and a different whorl section. For all these reasons we retain here an independent status for the two species.

Like E. martini, E. buxtorfi has an early "royerianum" stage, but this character disappears faster, at about d = 12mm. The cross-section becomes subrectangular, and the costulation may consist of 16 relatively widely spaced ribs as in the original material of JACOB & TOBLER (1906, PI. I, figs. 9.a-b, 10.a-b, 11.b & d-e). E. buxtorfi differs from E. tschernyschewi in having a narrower umbilicus. Moreover, the species of SINZOW (1906) has higher and broader whors and more numerous ribs.

Occurrence: Middle Aptian (Gargasian); Epicheloniceras martini Zone, Epicheloniceras buxtorfi Subzone, La Marcouline Quarry section.

Epicheloniceras waageni (ANTHULA, 1899)

(Pl. 22, figs. 1-3; Pl. 24, fig. 3)

1899 Pachydiscus Waageni ANTHULA, p. 106, PI. 9, figs. 1-a-c.
1906 Douvilleiceras meyendorfii var. waageni (ANTHULA); SINZOW, p. 164, PI. 1, fig. 10.
1913 Douvilleiceras Meyendorfii d’Orb. var. Waageni ANTH.; SINZOW, p. 109, PI. VI, fig. 9, figs. 1.a-c.
1914 Douvilleiceras waageni (ANTHULA); KAZANSKY, p. 61, PI. 3, figs. 37-38.
1960 Epicheloniceras waageni (ANTHULA); KUDRIAVTSEV, p. 342, PI. 20, figs. 1-2; PI. 21, fig. 1; PI. 22, fig. 1.
1962 Cheloniceras waageni ANTH.; COLLIGNON, p. 40, PI. CCXXXI, fig. 989.
1997 Epicheloniceras waageni (ANTHULA); IMUEL et alii, p. 182, PI. 5, fig. 3.
2004 Epicheloniceras waageni (ANTHULA); SHARIKADZE et alii, p. 358-359, PI. 49, fig. 1.

Material: 8 large specimens: CG921, CG951, D11, D10, CG922, CG920 CG948 and numerous fragments of whors.
Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|--------|------------|
| CG921    | 325| 134| ~82| 62 | 36 | -  | 0.462  | S/E        |
| CG950    | 306| 74 | 122.5 (110 d=200) | 57 (d=200) | 34 | d=242 | 0.577 (d=200) | S/E        |
| CG951    | ~246| 108.5| ~56| 55 | 38 | -  | 0.506  | S/E        |
| D11      | 220| 97 | -  | 45 | 38 | -  | 0.463  | S/E        |
| D10      | 164| 81 | 45.5| 32 | 38 | -  | 0.395  | S/E        |
| CG922    | 163| 75.5| 44 | 38 | 38 | -  | 0.503  | S/E        |
| CG920    | 156| 63 | 42.2| 32 | 34 | -  | 0.507  | S/E        |
| CG948    | 115.2| 59 | 23 | 32 | 35 | -  | 0.542  | S/E        |

Description: Semi-evolute shell conforming with the specimen figured by Anthula (1899, p. 106, Pl. 9, figs. 1.a-c). Whorls strongly inflated, wide-oval cross section, rounded venter, flanks high and moderately convex, umbilicus moderately wide. Feeble elongated tubercles at mid-flanks. Ribbing consists of main ribs forking at the umbilical wall into two or three branches and in two or three simple intermediate ribs. All these ribs are slightly inclined backward on the flanks, except on the final whorl.

Remark: Our material is composed of large shells (D maximum = 325 mm), but they are often distorted, so the measurements of these fossil forms do not reflect the dimensions of the specimens before their burial.

Occurrence: Middle Aptian (Gargasian); *Parahoplites melchioris* Zone, La Marcouline Quarry section.

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**Epicheloniceras tschernyschewi** (Sinzow, 1906)

(Pl. 16, figs. 6-8 & 10; Pl. 18, fig. 3; Pl. 20, figs. 1.a-c; Pl. 21, figs. 5-6)

1906 *Douvilleiceras tschernyschewi* Sinzow, p. 182, Pl. II, figs. 11-12; Pl. III, figs. 2-8, non fig. 1.

1954 Cheloniceras (Epicheloniceras) tschernyschewi (Sinzow); Casey, p. 113.

1962 Cheloniceras (Epicheloniceras) tschernyschewi (Sinzow); Casey, p. 236, Pl. XXVIII, fig. 6; Pl. XXXIX, figs. 6-7; text-fig. 82.

1962 *Cheloniceras* (Epicheloniceras) claudi Casey, p. 247, Pl. XXXVII, fig. 5; Pl. XXXIX, figs. 4.a-b; text-figs. 86.e & 87.

1962 *Cheloniceras* (Epicheloniceras) sellindgense var. audax Casey, p. 253, Pl. XXXVII, figs. 8.a-b; text-fig. 86.d.

1964 *Cheloniceras* tschernyschewi (Sinzow); Kemper, p. 49, Pl. 11, fig. 5; Pl. 15, fig. 3.

1999 *Epicheloniceras* gr. tschernyschewi (Sinzow); Cecca et ali, Pl. 2, fig. 1; Pl. 3, fig. 1.

2004 *Epicheloniceras* tschernyschewi (Sinzow); Shariadze et ali, p. 339, Pl. 32, fig. 2; Pl. 41, fig. 1; Pl. 42, fig. 1; Pl. 43, fig. 1; Pl. 44, fig. 1.

2005 *Epicheloniceras* tschernyschewi (Sinzow); Dutour, p. 170-173, Pl. 25, figs. 9-11.

Material: RG2010, CG970, CG971, PRAG 2000, PRAG 1998, PRAG 2012, PRAG 2014, and numerous fragments.

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Measurements:

| specimen | D  | Wh | Uw | Wb | K  | Ph | Wb/Wh | morphotype |
|----------|----|----|----|----|----|----|--------|------------|
| RG2010   | 146| 65.7| 28 | 54.5| 34 | -  | 0.82   | S/E        |
| CG970    | 99 | 45 | 22.6| 23 | 34 | -  | 0.51   | S/E        |
| CG971    | 87 | 42 | 20 | 33 | 32 | -  | 0.54   | S/E        |
| PRA2000  | 65 | 39 | 13 | 34 | 34 | -  | 0.37   | S/E        |
| PRAG 1998| 50 | 23.8| 12 | 30 | 34 | -  | 0.84   | S/E        |
| PRAG 2012| 29 | 14.5| 9  | ~13| 10 | -  | 0.59   | S/E        |
| PRAG 2014| 29 | 14 | 8.8| ~13| 24 | -  | 0.92   | S/E        |

Description: Semi-evolute ammonite with strongly inflated whorls. Umbilicus about 35 per cent of the total diameter. The nucleus is indistinguishable from that of *Epicheloniceras martini*. On juvenile whorls the main ribs have three pairs of strong tubercles: umbilical, lateral and ventro-lateral. The umbilical tubercle is short and thorn-like; the lateral tubercle is situated in the middle of the flank and is radially elongated, but in later whorls it can develop into a sharp and high tubercle. From these tubercles the main ribs fork into two unequal branches, the anterior one being stronger than the posterior one. Between the main ribs there are one two or three thinner intercalary ribs. On adult shells the
tuberculation can disappear and all the ribs are denser, become equal and inclined backward on the flanks.

Discussion: This species shows a great variability. Some specimens have a less dense ribbing, a coarser sculpture and a wider umbilicus. Specimens collected in the La Marcouline Quarry section are similar to the topotype illustrated by CASEY (1962, text-fig. 82, fig. d).

Occurrence: Middle Aptian (Gargasian); *Epicheloniceras buxtorfi* Subzone, beds 56 - 62, *Parahoplites melchioris* Zone beds 64 – 81, La Marcouline Quarry section.

**Subfamily Roloboceratinae**

**CASEY, 1954**

**Genus Roloboceras**

**CASEY, 1954**

Type-species: *Ammonites hambrovi* FORBES 1845 (p. 354, Pl. 13, fig. 4)

Diagnosis: Semi-evolute shell, with deep and wide umbilicus, semi-circular or subtrapezoidal whorl-section, whorls inflated, increasing moderately in height, rounded venter at all stages of growth. High, flat umbilical wall. Ornament can consist of thick robust ribs passing over the venter and radially ornamented with lateral bullae or strong blunt tubercles. Some species may have robust main ribs with two, three or four intercalated secondary ribs, without tubercles, bifurcating at mid-flank or on the umbilical border. Tubercles can become very large (being almost comparable to those of *Megatyloceras*) in certain juvenile specimens such as those of *Roloboceras horridum* SPATH (Pl. 12, fig. 3).

Remark: Casey (1961b) suggested that in Great Britain the Roloboceratinae are "isolated stratigraphically from the Cheloniceratinae, though occurrences elsewhere in Europe show that the ranges of the two subfamilies overlap in the middle of the Lower Aptian" (p. 177).

This is confirmed in the Cassis-La Bédoule area, in the Comte Quarry, where the Subfamily Roloboceratinae first occurs in bed 148 [*Roloboceras hambrovi* (FORBES)] and disappears in bed 170 [*Roloboceras hambrovi* Casey], whereas between these two beds, two or three large strong ribs passing right on the venter. All ribs are equal, flattened and radial.

Material: three specimens : PRA1430, PRA1435 (ex ABR 1220 : ROPOLO et alii, 2006, Pl. 11, fig. 2)

| Specimen | D | Wh | Ulw | Wb | K | Ph | Wb/Wh | Morphotype |
|----------|---|----|-----|----|---|----|-------|------------|
| PRA1435  | 171 | 64 | 37.2 | 101 | 25 | -  | 1.57   | S/E        |
| PRA1430  | 55  | 21 | 13.8 | 24  | 24 | -  | 1.14   | S/E        |

Description: Semi-evolute shell with very inflated whorls, increasing moderately in height, wide-oval to subtrapezoidal whorl section, rounded venter, vertical umbilical wall, deep umbilicus. Ornament can consist of strong peri-umbilical tubercles becoming radially elongated bulges or strong nodes, each giving rise to one, within the Deshayesites deshayesi Zone (precisely in the *Roloboceras hambrovi* and *Paradeshayesites grandis* subzones), we collected also *Cheloniceles kiliani*, *C. seminodosum*, *C. quadrarium*, *C. parinodum*, *C. disparile*, *C. crassum*, *C. mackesoni*, etc.

**Roloboceras hambrovi**

**(FORBES, 1845)**

(Pl. 6, fig. 2)

- 1845 *Ammonites Hambrovii* FORBES, p. 354, Pl. 13, fig. 4.
- 1847 *Ammonites Hambrovii* FORBES; FITTON, p. 299-300.
- 1850a *Ammonites Hambrovii* [sic] FORBES; d’ORBIGNY, p. 113.
- 1860 *Ammonites Hambrovii* FORBES; PICTET & CAMPICHE, p. 339.
- 1865 *Ammonites Arnaudi* COQUAND, p. 48, Pl. 2, figs. 1-2.
- 1906 *Ammonites Hambrovii* FORBES; SINZOW, p. 162-163.
- 1910 *Douvilleiceras Hambrovii* FORBES sp.; KILIAN, p. 341.
- 1915 *Douvilleiceras Hambrovii* FORBES sp.; KILIAN & REBOUL, p. 50.
- 1921 *Cheloniceras hambrovii* (FORBES); SPATH, (1923)p. 317, Pl. 8, fig. 3.
- 1927 *Douvilleiceras cf. Hambrovii* (FORBES); ROCH, Pl. 1, fig. 3.
- 1930 *Cheloniceras hambrovii* (FORBES); SPATH, p. 444-445 (pars).
- 1933 *Cheloniceras hambrovii* (FORBES); ROUCHADZE, p. 195.
- 1954 *Roloboceras hambrovii* (FORBES); CASEY, p. 114.
- 1957 *Roloboceras hambrovii* (FORBES); WRIGHT (in ARKELL et alii), p. L384-L385, fig. 501, 9.a-b.
- 1961b *Roloboceras hambrovii* (FORBES); CASEY, p. 179-182, text-figs. 55.a-b; Pl. 32, figs. 5.a-b.
- 1972 *Roloboceras sp. ex. gr. arnaudi* (COQUAND); SORNAY & MARIN, p. 108, Pl. B, fig. 4.
- 2006 *Roloboceras hambrovii* (FORBES); ROPOLO et alii, Pl. 11, fig. 2.

Measurements:

| Specimen | D | Wh | Ulw | Wb | K | Ph | Wb/Wh | Morphotype |
|----------|---|----|-----|----|---|----|-------|------------|
| PRA1435  | 171 | 64 | 37.2 | 101 | 25 | -  | 1.57   | S/E        |
| PRA1430  | 55  | 21 | 13.8 | 24  | 24 | -  | 1.14   | S/E        |
Arnaudi", described and illustrated by COQUAND (1865, p. 48, Pl. 2, figs. 1-2) from a specimen collected by this author in the Aptian of Rosa (Aragon, Spain), but certainly idealized as was usual at that time, could be united with the species of FORBES. This taxon presents the general aspect of Roloboceras hambrovi, but differs in its more regular and stronger ribbing and a lesser number of umbilical tubercles. SORNAY & MARIN (1972, Pl. B, fig 4) figured a deteriorated shell that they named Roloboceras sp. ex. gr. arnaudi. These two specimens are within the range of variability in Roloboceras hambrovi.

Occurrence: Deshayesites deshayesi Zone (Roloboceras hambrovi Subzone), Comte Quarry section.

Measurements:

| Specimen | D  | Wh | Uw | Whb | K | Ph | Wb/Wh | Morphotype |
|----------|----|----|----|-----|---|----|--------|------------|
| C.104    | 90 | 35 | 32 | ~50 | - | -  | 0.71   | E          |

Description: Our specimen (originally described and figured by CONTE (1975, figs. 2-3) was identified by SORNAY (pers. comm. to G. CONTE) as belonging to the Roloboceras transiens group. It is a slightly compressed shell, with a semi circular whorl section. At D = 60 mm there are eight strong peri-umbilical tubercles and at D= 70 mm there are ten. On the last whorl, these tubercles become radially elongated bulges. Ribbing is not visible in the juvenile stage, but on the adult whors each tubercle gives rise to a group of three thick blunt ribs passing on the venter.

Discussion: Our specimen shares some similarities with Roloboceras hambrovi (FORBES), but shows radial peri-umbilical tubercles forming prominent elongated nodes, which differ in shape from those of FORBES's species. In addition, its umbilical wall is higher and steeper in slope.

Occurrence: Deshayesites deshayesi Zone (Roloboceras hambrovi Subzone), Comte Quarry section.

Measurements:

| Specimen | D  | Wh | Uw | Whb | K | Ph | Wb/Wh | Morphotype |
|----------|----|----|----|-----|---|----|--------|------------|
| PRA1455  | 33.5 | 13 | 14 | 25.2 | 10 | -  | 1:50   | E          |

Description: Our specimen is conformable with that of figs. 5.a-b, Pl. 31 of CASEY (1961a). Very depressed juvenile whors, massive tubercles similar to those of Megatyloceras, ending in strong main ribs. Between primary ribs are intercalated one, two or three secondary ribs devoid of tubercles. Deep umbilicus, coronate whorl section with spinose lateral tubercle.

Discussion: This form, rare at La Bédoule, is found in the Deshayesi Zone (Grandis Subzone). It has many similarities with Cheloniceras royerianum d'ORBIGNY, 1841, from the Furcata Zone. CASEY (1961b, p. 185) points out that Roloboceras horridum has an early royerianum-stage (the venter becomes smooth, without intercalary ribs), with a brief succeeding "peri" stage, followed by the characteristic "horridum" stage characterized by the obsolescence or enfeeblement of the ribbing, between two main ribs on the rounded venter. Some adult specimens may show an early loss of gross tubercles.

Occurrence: Lower Aptian, Deshayesites deshayesi Zone (Paradeshayesites grandis Subzone), Comte quarry section.

Roloboceras sp. gr. transiens

CASEY, 1961

(Pl. 8, fig. 2)

1961b Roloboceras (?) transiens sp. nov. CASEY, text-fig. 56 in p. 187.

1972 Roloboceras sp. ex. gr. transiens CASEY; SORNAY & MARIN, p. 108-109, Pl. C, fig. 4.

1975 Roloboceras sp. groupe transiens CASEY; CONTE, p. 105-110, figs. 2-3.

Material: One specimen : n° C.104

Roloboceras horridum

SPATH, 1930

(Pl. 12, fig. 3)

1930 Cheloniceras hambrovi (FORBES) var. "horrida"; SPATH, p. 444.

1949 Megatyloceras hambrovi (FORBES) var. "horrida"; HUMPHREY, p. 149.

1954 Roloboceras hambrovi (FORBES) var. "horrida" SPATH; CASEY, p. 114.

1961b Roloboceras horridum (SPATH); CASEY, p. 185-186, Pl. 31, figs. 5.a-b; Pl. 32, figs. 1-4.

Material: One specimen, n° PRA1455
**Roloboceras sp.**

Material: a poorly preserved specimen, doubtfully identified as a half whorl of *Roloboceras sp.* No PRA1411.

Measurements:

| specimen | D     | Wh | Uw  | Wb  | K   | Ph | Wh/Wb | morphotype |
|----------|-------|----|-----|-----|-----|----|-------|------------|
| PRA1411  | 92.5  | 35 | 30.2| 18  | 12  | -  | 0.51  | E          |

Description: A crushed half whorl. Sculpture consists of twelve strong straight ribs with irregular disposition of peri-umbilical smooth tubercles. Umbilicus about one third of the diameter.

Discussion: This specimen in some respects is similar to *Roloboceras hambrovi* (FORBES), but its ribs are less numerous and more radial. It could be construed as a *Roloboceras hispanicum* var. *rotundatum* SORNAY & MARIN (1972), but this shell is preserved too poorly and its sculpture is too irregular for it to be attributed unreservedly to any species of *Roloboceras*.

Occurrence: Lower Aptian, *Deshayesites deshayesi* Zone (*Roloboceras hambrovi* Subzone).

**Genus Megatyloceras**

**Humfrey, 1949**

Type-species: *Douvilleiceras coronatum* ROUCHADZE 1933 (p. 195, fig. 12, Pl. 3, fig. 4).

**Megatyloceras ricordeanum**

**(d’Orbigny, 1850)**

(Pl. 8, fig. 3; Pl. 9, fig. 4; Pl. 11, fig. 3)

1850 Ammonites ricordeanum d’Orbigny, Pl. 8, figs. 7-8.

1967 *Megatyloceras bonchevi* sp. n. DIMITROVA, p. 167, Pl. 85, fig. 1; Pl. 86, fig. 3.

Material: three complete specimens: PRA1424, C.865, PRA1425, some fragments.

**Genus Megatyloceras**

**Humfrey, 1949**

**Type-species:** *Douvilleiceras coronatum* ROUCHADZE 1933 (p. 195, text-fig. 12; Pl. 3, fig. 4).

**Megatyloceras ricordeanum**

**(d’Orbigny, 1850)**

(Pl. 8, fig. 3; Pl. 9, fig. 4; Pl. 11, fig. 3)

1850 Ammonites ricordeanum d’Orbigny, Pl. 8, figs. 7-8.

1967 *Megatyloceras bonchevi* sp. n. DIMITROVA, p. 167, Pl. 85, fig. 1; Pl. 86, fig. 3.

Material: three complete specimens: PRA1424, C.865, PRA1425, some fragments.

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483

**Megatyloceras sp. aff. coronatum**

**(ROUCHADZE, 1933)**

1933 *Douvilleiceras coronatum* ROUCHADZE, p. 195, fig. 12, pl. 3, fig. 4.

1972 *Megatyloceras coronatum* (ROUCHADZE) var. *ibericum* SORNAY & MARIN p. 11, Pl. B, figs. 1-2; Pl. D, figs. 4 & 8.

2005 *Megatyloceras coronatum* (ROUCHADZE); KOTETISHVILI et alii, p. 386, Pl. 95, figs. 3a-3b.

Material: a distorted half whorl: nº PRA1483
Occurrence: Lower Aptian, Deshayesites deshayesi Zone (Roloboceras hambrovi Subzone).

4. Conclusion

This study of the Douvilleiceratidae from the Lower and middle Aptian of the Bedoulian stratotype area allowed us to determine the precise stratigraphic position and succession of every group of this important Aptian ammonite family. The Lower and middle Aptian sequence is characterized by five successive genera (or subgenera):

- **Procheloniceras** (from Martelites sarasinii to Deshayesites weissi zones),
- **Cheloniceras** (Deshayesites deshayesi Zone to the base of the Epicheloniceras debile Subzone),
- **Roloboceras** (Deshayesites deshayesi Zone),
- **Megatyloceras** (Deshayesites deshayesi Zone),
- **Epicheloniceras** (Epicheloniceras martini and Parahoplites melchioris zones).

These five groups share similar morphological features and have numerous affinities. Consequently, distinguishing between two large adult specimens of Cheloniceras and Epicheloniceras is quite difficult. The initial stages of the nuclei are often identical. There is a common "royerianum" stage between the last representatives of Cheloniceras and of the first Epicheloniceras. Juveniles pose particular problems and because of these similarities, it is not always easy to recognize forms transitional between two genera. Their evolution seems generally to be progressive, particularly within the beds transitional from the uppermost Bedoulian to the lower Gargasian. Provisionally, we have chosen the first appearance of the genus Epicheloniceras to be an important biostratigraphical marker for the base of the middle Aptian. However, this datum must be confirmed. So we recommend that the extinction of the genus Dufrenoyia also be considered for this purpose. Finally we propose here an updated biozonation for the Lower / middle Aptian of the Cassis-La Bédoule area (Fig. 6). Several stratigraphic markers, already defined in other regions (CASEY et alii, 1998) have been identified at Cassis-La Bédoule, such as Roloboceras hambrovi (FORBES)*, Cheloniceras meyendorffi (d'ORBIGNY), Epicheloniceras debile CASEY, Epicheloniceras gracile CASEY, Epicheloniceras buxtorfi (JACOB). The recognition of these subdivisions facilitates correlations with the Boreal realm.

* Although at Cassis-La Bédoule this species appears to be a marker of the middle upper Bedoulian, in southern England it is restricted to the upper lower Bedoulian.

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5. Bibliographic references

Aguado R., Company M., Sandoval J. & Tavera J.M. (1997).- Biostratigraphic events at the Barremian / Aiptanian boundary in the Betic Cordillera, southern Spain.- *Cretaceous Research*, London, vol. 18, n° 3, p. 309-329.

Anthula D.J. (1899).- Über die Kriedefossilien des Kaukasus.- *Beiträge zur Paläontologie und Geologie von Österreich-Ungarn und des Orient*, Wien, vol. XII, p. 55-160.

Bogdanova T.N. (1971).- Lower Aptian and boundary beds of west and south Turkmenia (Stratigraphy, ammonites).- Avtoref. Diss. na soiskanie uchenoi stepenni kandidata geologo-mineral. Nauk., 30 p. (in Russian)

Casey R. (1954).- New genera and subgenera of Lower Cretaceous ammonites.- *Journal of the Washington Academy of Science*, vol. 44, n° 4, p. 106-115.

Casey R. (1961a).- The stratigraphical palaeontology of the Lower Greensand.- *Palaeontological Society Monographs*, London, vol. 3, pt. 4, p. 487-621, pls. 77-84.

Casey R. (1961b).- A monograph of the Ammonoidea of the Lower Greensand. Part 3.- *Palaeontological Society, London*, p. 119-216.

Casey R. (1962).- A monograph of the Ammonoidea of the Lower Greensand. Part 4. *Palaeontological Society, London*, p. 217-288.

Casey R. (1980).- A monograph of the Ammonoidea of the Lower Greensand: Part IX.- *Palaeontological Society Monographs*, London, vol. 133 (1979), p. 633-660.

Casey R., Bayliss H.M. & Simpson M.I. (1998).- Observations on the lithostratigraphy and ammonite succession of the Aptian (Lower Cretaceous) Lower Greensand of Chale Bay, Isle of Wight, UK.- *Cretaceous Research*, London, vol. 19, n° 4, p. 511-535.

Cecca F., Dhondt A.V. & Bogdanova T.N. (1999).- The Aptian stratigraphy of the southern Tuarkyr (NW. Turkmenistan,
M. & BELLIER J.-P. (2004). - The Gargasian (Middle Aptian) of Cassis-La Bédoule (Lower Aptian historical stratotype, SE France): geographic location and lithostratigraphic correlations.- Carnets de Géologie / Notebooks on Geology, Maintenon, Letter 2004/02 (CG2004_L02), 4 p.

MOULLADE M., TRONCHETTI G. & BELLIER J.-P. (2005). - The Gargasian (Middle Aptian) strata from Cassis-La Bédoule (Lower Aptian historical stratotype, SE France): planktonic and benthic foraminiferal assemblages and biostratigraphy.- Carnets de Géologie / Notebooks on Geology, Brest, Article 2005/02 (CG2005_A02), 20 p.

MOULLADE M., TRONCHETTI G. & BELLIER J.-P. (2008). - Associations and biostratigraphy of the Foraminiferae benthiques and planctoniques du Bédoulien sommital and of the Gargasian inférieur de La Tuilière - St-Saturnin-lès-Apt (aire stratotype de l’Aptien, Vaucluse, SE France).- Carnets de Géologie / Notebooks on Geology, Brest, Article 2008/01 (CG2008_A01), 50 p.

NIKCHITCH J. (1915). - Représentants du genre Douvilleiceras de l’Aptien du versant septentrional du Caucase.- Mémoire du Comité géologique, n. s., livr. 121, Librairie scientifique A. Hermann, Paris, 53 p.

ORBIIGNY A. d’ (1841). - La Paléontologie française. Description des mollusques et rayonnés fossiles - Terrains Crétacés. Tome Premier. Céphalopodes.- Masson, Paris, 662 p. (final edition).

ORBIIGNY A. d’ (1845) In: MURCHISON R.I., de VERNEUL E. & de KEYSERLING, Géologie de la Russie d’Europe et des montagnes de l’Oural.- London & Paris, vol. II, pt. 3, p. 419-498.

ORBIIGNY A. d’ (1850a). - Prodomo de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés.- Masson, Paris, vol. 2, 428 p.

ORBIIGNY A. d’ (1850b). - Notes sur quelques espèces remarquables d’Ammonites dans l’aire stratotype de l’Aptien, Vaucluse, SE France. - Journal de Conchyliologie, Paris, p. 196-201.

PARONA C.F. & BONARELLI G. (1897). - Fossili albiani d’Escragnolles, del Nizzardo e della Liguria occidentale.- Paleontographia Italica, Pisa, vol. 2, p. 53-112.

PICTET F.J. & CAMPICHE G. (1858-1864). - Description des fossiles du Terrain Crétacé des environs de Ste Croix.- Matériaux pour la Paléontologie suisse, Genève, 380 p., 53 pls. (1858-1860); 752 p., 98 pls. (1861-1864).

RAWSON P.F. (1983). - The Valanginian to Aptian stages - current definitions and outstanding problems. In: Symposium Kreide.- Zitteliana, München, Heft 10, p. 493-500.

REBOULT S. & HOEDEMAEKER P.J. (reporters), AGUIRRE URRETA M.B., ALSEN P., ATROPS F., BARABOSKIN E.Y., COMPANY M., DELANDA G., DUTOIR Y., KLEIN J., LATIL J.L., LUKEENEDER A., MITTA V., MOURGUES F.A., PLOCH I., RAISSE-SSADAT N., ROPOLO P., SANDOVAL J., TAVERA J.M., VASICEK Z., VERMEULEN J., ARNAUD H., GRANIER B. & PREMOLO-SILVA I. (2006). - Report on the second international meeting of the IUGS Lower Cretaceous Ammonite Working Group, the "KILIAN Group" (Neuchâtel, Switzerland, 8 September 2005).- Cretaceous Research, London, vol. 27, n° 5, p. 712-715.

ROCH E. (1927). - Étude stratigraphique et paléontologique de l’Aptien inférieur de la Bédoule près Cassis (Bouches-du-Rhône).- Mémoire de la Société Géologique de France, Paris, (N.S.), t. IV, n° 8, 37 p.

ROMAN F. (1938). - Les Ammonites jurassiens et crétaçéens.- Masson, Paris, 554 p.

ROPOLO P., GONNET R. & CONTE G. (1999). - The ‘Pseudocrioceras interval’ and adjacent beds at La Bédoule (SE France): implications to highest Barremian/lowest Aptian biostratigraphy.- In: RAWSON P.F. & HOEDEMAEKER P.J. (eds.), Proceedings 4th International Workshop Cephalopod Team (IGCP-Project 362)- Scripta Geologica, Leiden, Special Issue 3, p. 159-213.

ROPOLO P., CONTE G., GONNET R. MASSE J.-P. & MOULLADE M. (2000). - Les faunes d’Ammonites du Barrémien supérieur/Aptien inférieur (Bédoulien) dans la région stratotypique de Cassis-La Bédoule (SE France) : état des connaissances et propositions pour une zonation par Ammonoites du Bédoulien-type. In: MOULLADE M. et alli (eds.), Le stratotype historique de l’Aptien inférieur (Bédoulien) dans la région de Cassis-La Bédoule (S.E. France).- Géologie méditerranéenne, Marseille, t. XXV, n° 3-4 (1998), p. 167-175.

ROPOLO P., MOULLADE M., CONTE G. & TRONCHETTI G. (2008). - About the stratigraphic position of the Lower Aptian Roloboceras hambrovi level.- Carnets de Géologie / Notebooks on Geology, Brest, Letter 2008/03 (CG2008_L03), 7 p.

ROPOLO P., MOULLADE M., GONNET R., CONTE G. & TRONCHETTI G. (2006). - The Deshayesitidae STOYANOV, 1949 (Ammonoidea) of the Aptian stratotype region at Cassis-la Bédoule (SE France).- Carnets de Géologie / Notebooks on Geology, Brest, Memoir 2006/01 (CG2006_M01), 46 p.

ROUCHADZE I. (1933). - Les ammonites aptiennes de la Géorgie occidentale.- Bulletin de l’Institut géologique de Géorgie (1932), Tbilisi, vol. 1, n° 3, p. 165-273.

SHARIKADZE M.Z., KAKABADZE M.V. & HOEDEMAEKER P.J. (2004). - Aptian and Early Albian Douvilleicerasidae, Acanthohoplitidae and Parahoplitidae of Colombia.- Scripta Geologica, Leiden, n° 128, p. 313-514.

SINZOW J. (1906). - Die Beschreibung einiger Douvilleiceras-Arten aus dem oberen Neoconan Russlands.- Verhandlungen der Russisch-Kaiserlichen Mineralogischen Gesellschaft zu St. Petersburg, (ser. 2), vol. 44, p. 157-198.
SINZOW J. (1909).- Beiträge zur Kenntniss des Sudrussischen Aptien und Albien.- Verhandlungen der Russisch-Kaiserlichen Mineralogischen Gesellschaft zu St Petersburg, (ser. 2), vol. 47, 48 p.

SINZOW I. (1913).- Beiträge zur Kenntnis der unteren Kreideablagerungen des Nord-Kaukasus.- Travaux du Musée Géologique Pierre le Grand près l’Académie Impériale des Sciences de St. Pétersbourg, t. VII, p. 93-117.

SORNAY J. & MARIN P. (1972).- Sur la faune d’ammonites aptiennes de la Tejeria de Josa (Teruel, Espagne).- Annales de Paléontologie, Invertébrés, Masson, Paris, t. 63, fasc. 1, p. 101-123.

SPATH L.F. (1923).- A monograph of the Ammonoidea of the Gault, pt. 1.- Palaeontological Society (1921), London, 72 p.

SPATH L.F. (1930).- On some ammonoidea from the lower Greensand.- Annals and Magazine of Natural History, London, (ser. 10), n° 5, p. 417-464.

UHLIG V. (1883).- Die Cephalopodenfauna der Wernsdorfer Schischten.- Denkschriften der kaiserlichen Akademie der Wissenschaften, Wien, Mathematisch-Naturwissenschaftlichen Klasse, vol. 46, 165 p.

VASICEK Z. (1972).- Ammonoidea of the Tesin-Hradiste Formation (Lower Cretaceous) in the Moravskoslezské Beskydy Mts.- Rozpravy Ustredniho Ustavu Geologického, Prague, vol. 38, 103 p.

VASICEK Z. (1997).- Ammonite stratigraphy of the pre-Albian Lower Cretaceous formations of the Western Carpathians (Czech and Slovak Republics).- Geologica Carpathica, Bratislava, vol. 48, n° 4, p. 231-242.

WRIGHT C.W. (1957).- In: ARKELL W.J., KUMMEL B. & WRIGHT C.W. Mesozoic Ammonoidea. In: MOORE R.C. (ed.), Treatise on Invertebrate Paleontology. Part L, Mollusca 4, Cephalopoda, Ammonoidea.- Geological Society of America & University of Kansas Press, New York & Lawrence, p. 80-490.
Plate 1:

1) *Procheloniceras pachystephanum* (UHLIG), n° PRB0419, bed 47, Upper Barremian, Waagenoides Zone – Le Brigadan section.
2) *Procheloniceras pachystephanum* (UHLIG), n° PRA1320, bed 64, Lower Aptian, Oglanlensis Zone – Les Caniers section.
3) *Procheloniceras pachystephanum* (UHLIG), n° PRA1322, bed 115, Lower Aptian, Weissi Zone – Les Fourniers section.
Plate 2:

1) *Procheloniceras stobieskii* (d’ORBIGNY) n° Sc Dw301, Lower Aptian, Weissi Zone – La Bédoule, indetermined bed, in Université de Provence, Marseille St Charles, DEROGNAT Collection.

2) *Procheloniceras albrechtiaustriae* (HÖHN.) *in* Uhlig, n° PRA1413, Lower Aptian, Weissi Zone – Les Fourniers section, bed 117.

3) *Procheloniceras albrechtiaustriae* (HÖHN.) *in* Uhlig, n° PRA1414, Lower Aptian, Weissi Zone – Les Fourniers section, bed 114.
Plate 3:

1) Procheloniceras albrechtiaustriæ (HOHN.) in UHLIG, no Sc Dw403, Lower Aptian, Weissi Zone – La Bédoule, indetermined bed, in Université de Provence, Marseille St Charles, DEROGNAT Collection.
2) Same specimen, ventral view.
Plate 4:

1) Procheloniceras dechauxi (Kilian & Rebull), n° Sc Dw302, Lower Aptian, Weissi Zone – La Bédoule, indetermined bed, in Université de Provence, Marseille St Charles, DEROGNAT Collection.
2) Procheloniceras albrechtiaustriae (Hohn.) in Uhlig, n° PRA1412, Lower Aptian, Weissi Zone – Les Fourniers section, bed 112.
3) Procheloniceras dechauxi (Kilian & Rebull), n° PRA1422, Lower Aptian, Weissi Zone – Les Fourniers section, bed 116.
Plate 5:

1) Procheloniceras stobieskii (d’ORBIGNY) sensu ROCH 1927, n° PRA1418, Lower Aptian, Weissi Zone, La Bédoule, Les Fourniers section, bed 115.
2) Procheloniceras stobieskii (d’ORBIGNY) n° PRA1417, bed 116, Lower Aptian, Weissi Zone, La Bédoule, Les Fourniers section.
3) Procheloniceras albrechtiaustriae (HOHN.) var. stobieskii (d’ORBIGNY), La Bédoule, in ROCH, 1927, Pl. 2, fig. 1.
4) Procheloniceras stobieskii (d’ORBIGNY) n° PRA1421, Lower Aptian, Weissi Zone, La Bédoule, Les Fourniers section, bed 121.
Plate 6:

1) *Cheloniceras crassum* SPATH - Université de Provence, Marseille-St. Charles, DEROGNAT Collection, nº Sc Dw12609 - Lower Aptian, Deshayesi Zone, La Bédoule, indetermined bed (labeled DS).
2) *Roloboceras hambrovi* (FORBES), nº PRA1430, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section, bed 148.
3) *Cheloniceras crassum* SPATH - nº C.821, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section bed 170a.
Plate 7:

1-2) *Cheloniceras crassum* SPATH – n° C.861, Lower Aptian, Deshayesi Zone, Comte quarry section, bed 166.
3) *Cheloniceras crassum* SPATH, n° C.859, bed 168, Lower Aptian, Deshayesi Zone, Comte quarry section, bed 168.
Plate 8:

1) *Cheloniceras kiliani* (KOENEN 1902) – n° SC 12900, Lower Aptian, Deshayesi Zone, Cassis-La Bédoule, probably Comte quarry section, indetermined bed, DEROGNAT Collection (labeled D4).

2) *Roloboceras* sp. gr. *transiens* CASEY 1961 – n° C.104, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section, bed 150.

3) *Megatyloceras ricordeanum* (d’ORBIGNY) – n° PRA1424, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section, bed 150.
Plate 9:

1) *Cheloniceras parinodum* CASEY – n° C.102 (right side), Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 170.

2) *Cheloniceras disparile* CASEY - n° PRA1452, Lower Aptian, Deshayesi Zone, Grandis Subzone e, Comte quarry section, bed 169.

3) *Cheloniceras parinodum* CASEY – n° C.103, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 166.

4) *Megatyloceras ricordeanum* (d’ORBIGNY) – n° C.865, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section, bed 158.
Plate 10:

1-3) Cheloniceras seminodosum (SINZOW), n° C.868, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 165.
2) Cheloniceras seminodosum (SINZOW), n° C.869, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 166.
4) Cheloniceras seminodosum (SINZOW), n° PRA1450, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 166.
5) Cheloniceras parinodum CASEY – n° C.102 (left side), Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 170.
Plate 11:

1-2) *Cheloniceras quadrarium* CASEY − n° C.912, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 168.

3) *Megatyloceras ricordeanum* (d’ORBIGNY) PRA1425, Lower Aptian, Deshayesi Zone, Hambrovi Subzone, Comte quarry section, bed 158.
Plate 12:

1) *Cheloniceras mackesonii* CASEY (D: 355.5 mm) nº PRA1451, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 164.
2) *Cheloniceras meyendorffii* (d’ORBIGNY) nº C.872, Lower Aptian, Furcata Zone, Comte quarry section, bed 174.
3) *Roloboceras horridum* CASEY, small specimen, nº PRA1455, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 170.
Plate 13:

1) *Cheloniceras mackesoni* CASEY (D = 410 mm) n° PRA1452, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 166.
Plate 14:

1) *Cheloniceras meyendorffi* (d'ORBIGNY), n° PRA1460, Lower Aptian, Furtata Zone, Comte quarry section, bed 176.
2.a-b) *Cheloniceras cornuelianum* (d'ORBIGNY) n° PRA1456, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 166.
Plate 15:

1.a-b) *Cheloniceras cornuelianum* (d'ORBIGNY) n° C.874 (1.a) & C.875 (1.b), Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 162 (1.a), bed 166 (1.b).
2) *Cheloniceras cornuelianum* (d'ORBIGNY) n° C.876, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 169.
3) *Cheloniceras cornuelianum* (d'ORBIGNY) n° C.877, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 169.
4) *Cheloniceras minimum* CASEY, n° C.878, Lower Aptian, Furcata Zone, Comte quarry section, bed 171.
5) *Cheloniceras seminodosum* (SINZOW) n° C.880, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 164.
6) *Cheloniceras seminodosum* (SINZOW) n° C.881, Lower Aptian, Deshayesi Zone, Grandis Subzone, Comte quarry section, bed 165.
Plate 16:

1) *Cheloniceras cornuelianum* (d'ORBIGNY) no C.890, middle Aptian (Gargasian), Martini Zone, Comte quarry, bed 169.
2) *Epicheloniceras martini* var. *martinioides* CASEY, no C.G. 901, middle Aptian (Gargasian), Martini Zone, La Marcouline section, bed 9.
3) *Epicheloniceras martini* (d'ORBIGNY) no C.G. 903, middle Aptian (Gargasian), Martini Zone, La Marcouline section, bed 7.
4) *Epicheloniceras martini* (d'ORBIGNY) no C.G. 902, middle Aptian (Gargasian), Martini Zone, La Marcouline section, bed 8.
5) *Epicheloniceras martini* (d'ORBIGNY) no C.G. 905, middle Aptian (Gargasian), Martini Zone, La Marcouline section, bed 28.
6) *Epicheloniceras tschernyschewi* (SINZOW), no PRAG 1998 middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 78.
7) *Epicheloniceras tschernyschewi* (SINZOW), no PRAG 1997 middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 74.
8) *Epicheloniceras tschernyschewi* (SINZOW), no PRAG 1999 middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 64.
9) *Epicheloniceras martini* var. *martinioides* CASEY, no C.G. 911, middle Aptian (Gargasian), Martini Zone, La Marcouline section, bed 10.
10) *Epicheloniceras tschernyschewi* (SINZOW), no PRAG 2000 middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 77.
Plate 17:

1.a-b) *Epicheloniceras debile* CASEY, n° PRAG 1476, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 8.

2) *Epicheloniceras debile* CASEY, n° PRAG 1482, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 10.
Plate 18:

1) *Epicheloniceras subnodosocostatum* (SINZOW), n° PRAG 1477, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 22.
2) *Epicheloniceras buxtorfi* (JACOB), n° PRAG 1510, middle Aptian (Gargasian), Martini Zone, Buxtorfi Subzone, La Marcouline section, bed 51.
3) *Epicheloniceras tschernyschewi* (SINZOW), n° PRAG 1478; middle Aptian (Gargasian), Martini Zone, Buxtorfi Subzone, La Marcouline section, bed 61.
4) *Cheloniceras mackesoni* CASEY La Bédoule, probably Comte quarry section, indetermined bed, DEROGNAT Collection.
Plate 19:

1.a-b) *Epicheloniceras gracile* CASEY, La Bédoule, probably La Marcouline quarry section, undetermined bed, DEROGNAT Collection, labeled D10.
Plate 20:

1.a) *Epichelonicerus tschernyschewi* (Sinzow), n° RG2010 middle Aptian (Gargasian), Melchioris Zone, Fontblanche section (side view), bed 21. (GONNET Collection)
1.b) Same specimen (front view).
1.c) Same specimen (ventral view).
Plate 21:

1) Epicheloniceras gracile, n° PRAG 1490, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 8.
2) Epicheloniceras buxtorfi (JACOB), n° PRAG 2011, ventral view middle Aptian (Gargasian), Martini Zone, Buxtorfi Subzone, La Marcouline section, bed 54.
3) Epicheloniceras eotypicum CASEY, n° PRAG 2017, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 26.
4) Epicheloniceras subnodosocostatum (SINZOW) n° CG46, middle Aptian (Gargasian), Gracile Subzone, La Marcouline section, bed 44.
5) Epicheloniceras tschernyschewi (SINZOW), n° PRAG 2012, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 74.
6) Epicheloniceras tschernyschewi (SINZOW), n° PRAG 2014, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 76.
7-8) Epicheloniceras eotypicum CASEY, n° PRAG 2015, middle Aptian (Gargasian), Martini Zone, Debile Subzone, La Marcouline section, bed 26.
Plate 22:

1) *Epicheloniceras waageni* (ANTHULA), n° C.913, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 74.
2) *Epicheloniceras waageni* (ANTHULA), n° C.914, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 75.
3) *Epicheloniceras waageni* (ANTHULA), n° C.915, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 76.

Plate 23:

1) *Parahoplites flexisulcatus* (d’ORBIGNY), n° C.964, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 65.
2) *Parahoplites flexisulcatus* (d’ORBIGNY) in ROCH, Pl. 1, fig. 2, Aptien, La Bédoule, “marnes à Parahoplites furcatus” (?), p. 19.
3) *Acanthohoplites* sp., n° C.967, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 66 [no scale].
Plate 24:

1) *Parahoplites* sp. n° C.919, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 64.
2) *Parahoplites multicostatus* SINZOW, n° PRA2016, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 78.
3) *Epicheloniceras waageni* (ANTHULA), n° C.920, middle Aptian (Gargasian), Melchioris Zone, La Marcouline section, bed 76.