THE APPEARANCE OF THE GENUS DESHAYESITES (KAZANSKY, 1914, AMMONOIDEA) IN THE LOWERMOST APTIAN (LOWER CRETACEOUS) OF LA BÉDOULE (SE FRANCE)

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Abstract. New palaeontological and biostratigraphical investigations were carried out at La Bédoule (SE France), which is the stratotype-area of the Bedoulian (Lower Aptian). The levels that directly overlie the last Barremian Pseudocrioceras-bearing bed have revealed the occurrence of a fauna characterized by previously undescribed macroconchs of the genus Deshayesites, that we have included in Deshayesites bedouliensis n. sp. and in D. aff. consobrinus (d’Orbigny). These forms are associated with the species Deshayesites antiquus Bogdanova, D. oglasrensis Bogdanova, D. cf. weissiformis Bogdanova, D. aff. weissiformis Bogdanova in Delanoy, D. cf. planicostatus Bogdanova, and D. aff. normani Casey. These ammonites characterize the basal Aptian Deshayesites tuarkyricus Zone. This Zone was defined in Turkmenistan but its recognition in the Mediterranean Tethys is confirmed by the present study. Contrary to previous assertions, the genus Prodeshayesites (which pre-dates Deshayesites in northern Germany and southern England), whose FAD was taken to mark the base of the Aptian, is absent at La Bédoule. Prodeshayesites is absent also in Turkmenistan and in all other Mediterranean localities. The FAD of the genus Deshayesites is taken to mark the base of the Aptian in the Mediterranean area.


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Fig. 1 - Geographical location of the La Bédoule area.
Introduction.

Historically, the sections outcropping in the Cassis-La Bédoule area (SE France) represent the lower part of the Aptian, which was named Bedoulian by Toucas (1888). The Comte quarry was studied for stratigraphic purposes and was considered the reference section for the Bedoulian (Roch, 1927; Fabre-Taxy et al., 1965; Flandrin, 1965; Moullade et al., 1980a, b; Busnardo, 1984). A detailed revision of the Bedoulian has been undertaken only recently (Delanoy et al., 1997; Moullade et al., 1998; Ropolo & Gonnet, 1999; Ropolo et al., in press; Gonnet et al., in prep.).

These authors showed a continuous succession of ammonites across the Barremian-Aptian boundary, particularly the occurrence of deshayesitids above the uppermost Barremian *Pseudocrioceras* beds.

New palaeontological and stratigraphic investigations in the Le Brigadan section (Fig. 1, 2), near the historical stratotype of the Bedoulian (Comte Quarry or La Bédoule-Cassis railway station), uncovered a new ammonite fauna in a level corresponding to beds 82-83 that directly overlies (Fig. 3) the last *Pseudocrioceras*-bearing bed 81 (belonging to the *M. sarasini* Zone, *Pseudocrioceras waageni* Subzone). This new fauna indicates the Early Aptian *Deshayesites tuarkycicus* Zone.

The fauna of the earliest Aptian *Deshayesites tuarkycicus* Zone reported from other sections of the La Bédoule area by Delanoy et al. (1997), Ropolo et al. (in print) and Gonnet et al. (in prep.) is derived from a horizon of the *D. tuarkycicus* Zone slightly younger than the level studied here.

The present paper describes this new ammonite fauna.

Stratigraphic position of the fauna.

The thickness of the level yielding the fauna studied in the present paper cannot be measured with precision at Le Brigadan due to the very gentle dip of the beds, and the stratigraphic relation between the underlying and overlying beds is difficult to see in detail. However, during recent field work we were able to recognize the stratigraphic relationships between the different beds (Fig. 3) and to establish that beds 82-83 can be distinguished in the stratigraphic columns described in other papers (Ropolo et al. in print; Ropolo & Gonnet, 1999) and actually correspond to a one and the same level.

Our stratimetric estimations indicate the thickness of this level to be between 0.60 and 0.80 m at Le Brigadan, but it is slightly thicker in the other sections of the La Bédoule area. Some elements of the new ammonite fauna were found only in the same stratigraphic level at the Highway A 52 section (Fig. 2).

The ammonite fauna collected in bed 83 of Le Brigadan section consists of:

- large Deshayesitidae: *Deshayesites bedouliensis* n. sp. and *D. aff. consobrinus* (d'Orbigny).
- *Kutatissites* sp., *Procheloniceras* sp. and *Toxoceratoides* sp.

These ammonites are associated with tiny bivalves and gastropods, transported from shallower areas, and a few specimens of *Cymatoceras neocomiense* (d'Orbigny).
Some of the ammonite species (Deshayesites antiquus, D. aff. weissiformis, D. cf. planicostatus, D. oglanlensis) characterize the Deshayesites tuarikyricus Zone in the Trans-Caspian area (Bogdanova et al. 1989, Bogdanova & Tovbina, 1995). Deshayesites antiquus is considered by Bogdanova & Tovbina (1995) to be one of the early representatives of the genus Deshayesitidae, and "...the deposits where it occurs, as the oldest Aptian deposits".... Numerous large evolute forms of undescribed Deshayesitidae also occur in the same beds, here interpreted as macroconchs due to their morphology and large size, and included in D. bedouliensis n. sp. Other forms, such as Kutatissites sp. or Toxoceratoides sp., are not characteristic of the Lower Aptian since they already occur in the underlying beds of the uppermost Barremian Pseudocrioceras waageni Subzone.

Systematic descriptions.

We follow the classification of the Cretaceous Ammonoidea by Wright et al. (1996).

The standard dimensions for normally coiled ammonites are given in millimetres and as percentages of the diameter. The following abbreviations were used:

- D = maximum diameter;
- d = diameter at which measurements were taken when smaller than D;
- Wh = whorl-height;
- Uw = umbilical width;
- Wb = whorl-breadth; the ratio Wb/Wh expresses the degree of compression of the whorl;
- K = number of ribs per half whorl;
- Ph = diameter of the end of the phragmocone ("n" means that the specimen is entirely septate);

The specimens are housed in the Collections de Provence of the University Aix-Marseille I, Centre de Sédimentologie et Paléontologie, St. Charles: numbers BW 001 to 075. The specimen RG 1456 is deposited in R. Gonnet's collection.

Superfamily Deshayesitaceae Stoyanow, 1949

Family Deshayesitidae Stoyanow, 1949

Subfamily Deshayesitinae Stoyanow, 1949

Genus Deshayesites Kazansky, 1914

Type-species Ammonites deshayesi d'Orbigny, 1840
**Deshayesites antiquus** Bogdanova, 1983

1979 *Deshayesites antiquus* Bogdanova, pl. 1, fig. 4.

1983 *Deshayesites antiquus* Bogdanova sp. nov., p. 138, pl. 2, fig. 5, 6, text-fig. 7.

**Material:** BW 015, 051.

**Description.** Small, evolute compressed shells with rounded flanks, narrow and rounded venter.

The ribbing is flexuous and consists of primary, secondary and intercalatory ribs; it generally weakens around mid-flank. Primary ribs, single or united in pairs, spring from umbilical tubercles; the point of branching is located on the upper third of the flank. All ribs describe a slight sinus on the venter.

**Dimensions.**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>D</th>
<th>Wh</th>
<th>Wb</th>
<th>Uw</th>
<th>Wb/Wh</th>
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<th>Ph</th>
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</thead>
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<td>-</td>
<td>7(0.26)</td>
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<tr>
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<td>14(0.42)</td>
<td>6.5(0.2)</td>
<td>90.27</td>
<td>-</td>
<td>-26</td>
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</tbody>
</table>

**Discussion.** The specimens clearly resemble one of the type-specimens described and illustrated by Bogdanova (1983, pl. 2, fig. 6).

**Deshayesites bedouliensis** n. sp.

Pl. 1, Fig. 1; Pl. 2; Pl. 3, Fig. 1, 2; Pl. 4, Fig. 1, 2; Pl. 6, Fig. 1; Pl. 7, Fig. 1; Pl. 8, Fig. 1.

**Derivatio nominis:** the name refers to La Bédoule, the type-locality.

**Holotype:** specimen BW 055, illustrated in Pl. 7, Fig. 1.

**Paratypes:** BW 006, 053, 054, 057, 058, 061, 062, 063, 067, 068, 069, 070, 071, 072, 073, 074, 075, 076, 077, 079, RG 1456.

**Type-locality:** Le Brigadan, near La Bédoule.

**Type-level:** *Deshayesites tuarkyricus* Zone, basal Aptian.

**Diagnosis.** Highly variable macroconch species characterized by more or less involute shells and by an ontogenetic change of both shell shape and sculpture. Internal whorls with numerous ribs, weakened on the flank, springing from a perumbilical tubercle. The ribbing becomes stronger, the umbilicus wider and the whorl height smaller on the body chamber, thus producing a strongly egressing whorl. This species exhibits a variability of the adult size, and an almost continuous variability in coiling from relatively involute to evolute specimens.

**Description.** In the phragmocone the shell is discoidal, more or less involute; the flanks are rounded and the umbilical wall is high and steep with a definite rounded edge. Some specimens have a rounded venter tending to flatten because of the sub-trapezoidal whorl section. The ribbing is weak, although there is a certain variability among the specimens. Further observations were not possible due to the poor preservation of our material. The ribs spring from a tubercle located on the umbilical edge, weaken on the flank, and their relief increases from the upper fourth of the flank and on the venter.

Both the whorl-shape and the ribbing abruptly change in the body chamber.

The whorl-height decreases considerably (see measurements) and the whorl-breadth increases while the umbilicus widens, thus producing both a narrowing and an egression of the whorl. This is particularly pronounced in the specimens included in the "evolute morphotype", whose last whorl just touches the venter of the preceding one; in this morphotype the umbilical wall tends to disappear and the shell loses its discoidal aspect at the end of the growth.

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**PLATE 1**

Fig. 1 - *Deshayesites bedouliensis* n. sp., involute morphotype, spec. BW 058. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.1. The second half of the body chamber is slightly deformed.

Fig. 2-4 - *Deshayesites oglanderi* Bogdanova: 2, spec. BW 002; 3, spec. BW 011A; 4, spec. BW 050. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1. The arrow indicates the beginning of the body chamber.

**PLATE 2**

*Deshayesites bedouliensis* n. sp., evolute morphotype, spec. RG 1456. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1. The arrow indicates the beginning of the body chamber.

**PLATE 3**

Fig. 1 - *Deshayesites bedouliensis* n. sp., involute morphotype, spec. BW 057. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 2 - *Deshayesites bedouliensis* n. sp., evolute morphotype, spec. BW 006. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1. The arrow indicates the beginning of the body chamber.
The ornamentation becomes increasingly stronger: the ribs are thick, rectiradiate or prorsiradiate in the lower part of the flank; in the upper half the ribs tend to be rursiradiate. There are single, intercalatory and biplicate ribs whose point of branching lies at mid-flank. The ribs become rursiradiate at the point of branching. The intercalary ribs start at different heights. Ribs show a very slight adoral convexity on the venter.

Dimensions of the specimens included in the "evo-

mulate morphotype".

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Dimensions of specimens included in the "involute morphotype".

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</table>

Discussion. It was impossible to compare the population described here as *D. bedouliensis* n. sp. with any other species of the genus *Deshayesites*. The lectotype of *D. consobrinus* (d'Orbigny), which Casey (1964, text-fig. 124 b) selected from the surviving syntypes, corresponds to a body chamber of a large deshayesitid showing some morphologic similarities with some specimens of *D. bedouliensis* n. sp., particularly a very slight whorl egression. It is worth noting that the concept of *D. consobrinus* was based on material from La Bédoule and that, in this context, the name *consobrinus* could be used for our population. In any case, d'Orbi-

-gny's original illustration shows (or, following Casey, was intended to show) an ammonite with strong and
distant ribs in the internal whorls that does not weaken at mid-flank. On the contrary, the population described here as *D. bedouliensis* n. sp. is characterized by densely ribbed internal whorls, almost smooth in some specimens. Due to its more distant, less numerous ribs, the lectotype of *D. consobrinus* does not belong to the population described here as *D. bedouliensis* n. sp.

The diameter at the beginning of the egression of the whorl, which is the feature characterizing the final growth stage, is highly variable and corresponds to the polymorphism of the adult size.

The involute specimens show some morphologic similarities with *D. grandis* Spath, which differs in its stronger ribbing and in the numerous single ribs at the end of the growth.

**Deshayesites oglanlensis** Bogdanova, 1983

Pl. 1, Fig. 2 - 4

1979 *Deshayesites oglanlensis* Bogdanova, pl. 2, fig. 5.
1983 *Deshayesites oglanlensis* Bogdanova sp. nov., pl. 1, fig. 5-9, text-fig. 5, 6.
1995 *Deshayesites oglanlensis* - Delanoy, p. 74, pl. 2, fig. 1.
> 1997 *Deshayesites oglanlensis* - Aguado, Company, Sandoval & Tave- ra, fig. 7e.
1997 *Deshayesites oglanlensis* - Delanoy, pl. 6, fig. 3.
> 1999 *Deshayesites aff. oglanlensis* - Avram, p. 441, fig. 4 B (only).

Material: BW 002, 004, 007, 011a, 021, 050.

Description. Small, evolute shells with almost flat flanks, narrow and rounded venter. The umbilical wall is low. Specimen BW 002 shows the innermost whorls which seem to be smooth up to at least 8 mm diameter. The ribbing consists of almost falcate ribs, which may be simple or biplicate, and intercalatory ribs; it tends to weaken around mid-flank. The secondary ribs are slightly thickened near the ventrolateral margin. The ribs originate from weak thickenings lying on the umbilical edge; these become bullae in the last whorl, approximately d = 20-25 mm. From this diameter the distance between the primaries increases as does the number of secondary ribs (3 to 5) between two primaries; it is also possible to see some extremely weak striae between the primaries. After d > 35 mm the ornamentation changes again: both the distance between two primaries and the number of intercalatory ribs decrease; the ribs are mainly biplicate.

**Deshayesites aff. weissiformis**

Bogdanova in Delanoy, 1995

Pl. 6, Fig. 2, 3

1991 *Paradeshayesites gr. laeviusculus* (Koenen) - Delanoy, p. 439, fig. 2d.
1995 *Deshayesites aff. weissiformis* Bogdanova - Delanoy, p. 74, pl. 5, fig. 2.

Material: BW 003, 022.

Discussion. The specimen that Delanoy (1995, 1997) illustrated twice shows strong morphologic similarities with those described in this paper. The specimens described by Bogdanova differ in having a less flexuous ribbing.

*D. planicostatus* Bogdanova shows some resemblance with the inner whorls; it differs in the more uniform ontogenetic development of the ornamentation, that does not weaken at mid-flank.

**Deshayesites cf. weissiformis**

Bogdanova, 1983

Pl. 6, fig. 4

Discussion. The specimens described are compared with the specimen illustrated twice by Delanoy (1991; 1995). This form shows some morphologic resemblance with *D. weissiformis* Bogdanova, but it differs from the latter in a stronger and more flexuous ribbing. It probably corresponds to a different species that has not yet been defined because more abundant material is needed.
Description and discussion. One slightly crushed fragment of a moderately evolute shell. The ornamentation consists of numerous, fine, falcoid, bundled ribs and intercalary ribs. The ribs spring from perumbilical bullae and bifurcate above the mid-flank.

Our specimen resembles one of the type-specimens illustrated by Bogdanova (1983), i.e. that of pi. 2, fig. 2. However, the ribbing of the latter specimen is finer.

The specimens described above as Deshayesites aff. weissiformis Bogdanova in Delanoy, 1995 differ from D. cf. weissiformis in their stronger and more variable ribbing. Moreover, it does not develop true perumbilical bullae.

Deshayesites aff. normani Casey, 1964

Material: BW 013

Description. One fragment corresponding to half a whorl of an evolute shell of about 62 mm.

The ribs are swollen and exceptionally strong. They consist of biplicate ribs springing from umbilical tubercles, with their point of branching located at the upper third of the flank. The ribs describe a gentle sinus on the venter.

Discussion. The specimen described recalls D. normani Casey because of the strong swollen ribs. However the umbilicus of our specimen is wider. D. normani was collected in England in a younger level (D. forbesi Zone, equivalent of the D. weissi Zone).

Deshayesites cf. planicostatus Bogdanova, 1991

Material: BW 005

Description. Small, moderately evolute whorl characterized by flexuous, simple and biplicate ribs branching between the middle and the upper third of the flank. The ribs spring from bullae located on the perumbilical edge. The secondary ribs are slightly thickened and flattened. All ribs cross the venter describing a convexity towards the aperture.

Dimensions.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>D</th>
<th>Wb</th>
<th>Wb/Wh</th>
<th>K</th>
<th>Ph</th>
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<tbody>
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<td>16 (0.42)</td>
<td>-</td>
<td>11 (0.29)</td>
<td>-28</td>
</tr>
</tbody>
</table>

Discussion. This specimen can be compared with the holotype of D. planicostatus Bogdanova (1991, pl. 2, fig. 1) which was collected in the D. tuarkyricus Zone of the Greater Balkan (Turkmenistan). The poor preservation of our specimen does not allow us to compare the relief of the perumbilical bullae with those of the type-specimens of D. planicostatus.

Deshayesites n. sp. A

Material: BW 023, 024, 025.

Description. Evolute shell with ovate whorl-section, rounded flanks, convex and narrow venter. The transition between the flank and the inclined umbilical wall is marked by perumbilical bullae; there is no true umbilical edge. The ornamentation consists of bundles of ribs springing from strong perumbilical bullae. Up to d ~ 45-48 mm the ribs tend to fade around mid-flank and only the secondary ribs are visible near the ventrolateral margin; they cross the venter describing an adorally convex sinus. From d~48 mm the relief of the ribbing increases and at this stage flexuous ribs branching around mid-flank are visible.

The suture-line is not preserved.

Dimensions.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>D</th>
<th>Wh</th>
<th>Wb</th>
<th>Uw</th>
<th>Wb/Wh</th>
<th>K</th>
<th>Ph</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW023</td>
<td>57</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>at 53</td>
<td>21 (0.39)</td>
<td>-</td>
<td>16 (0.30)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>at ~40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
</tr>
</tbody>
</table>

BW025    | 66 | 30.5 (0.46) | ~12 (0.18) | 18 (0.27) | 0.39 | 31 | - |

Discussion. The specimens described here as Deshayesites n. sp. A cannot be identified with any of the species described in the literature. The specimens available are not sufficiently preserved to define a new species.

Deshayesites n. sp. B

Material: BW 001, 080, 081

Description. Evolute shell with flat flanks, rounded and relatively wide venter. The ribbing is fine and falcoid. The ribs are both intercalatory, stopping at mid-flank or lower, and biplicate, whose point of branching lies at mid-flank. All secondary ribs describe an adoral sinus on the venter. Some ribs are united in bundles that spring from the umbilical edge.

Dimensions.

<table>
<thead>
<tr>
<th>Specimen</th>
<th>D</th>
<th>Wh</th>
<th>Wb</th>
<th>Uw</th>
<th>Wb/Wh</th>
<th>K</th>
<th>Ph</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW001</td>
<td>~41</td>
<td>16.5 (0.40)</td>
<td>-</td>
<td>11.5 (0.28)</td>
<td>-</td>
<td>40</td>
<td>-</td>
</tr>
</tbody>
</table>
Discussion. The specimens described are characterized by the lack of periumbilical bullae, fine ribbing and a relatively wide venter. They cannot be identified with any described species of *Deshayesites*. A more abundant and better preserved material is needed to clarify the taxonomic status of this form.

*Deshayesites aff. consobrinus* (d’Orbigny, 1841)

Pl. 9, Fig. 1

**Material:** BW 066.

**Description.** Evolute, discoidal shell with an ovate, compressed whorl section and a steep, relatively high umbilical wall. Distant, strong simple ribs, intercalatory and biplicate ribs branching at the upper third of the flank. The ribs are prorsiradiate in the lower half of the flank and slightly rursiradiate in the upper half. The intercalatories are more numerous than the secondaries.

**Dimensions.**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>D</th>
<th>Wb</th>
<th>Wb/Wh</th>
<th>Wh</th>
<th>Wh/Wh</th>
<th>K</th>
<th>Ph</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW 066</td>
<td>-200</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>at 188</td>
<td>68 (0.36)</td>
<td>35 (0.19)</td>
<td>66 (0.35)</td>
<td>0.51</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion.** The distant and strong ribbing in the penultimate whorl and the high and steep umbilical wall in the body chamber separate this specimen from those included in *D. bedouliensis* n. sp., which is characterized by finer and weaker ribbing in the penultimate whorl. Both ribbing and shell shape resemble *D. consobrinus* (d’Orbigny), whose original illustration (1841, pl. 47) shows less numerous ribs and a more compressed shell.

According to Casey (1964), the original illustrations of this species by d’Orbigny (1841, pl. 47) “are synthetographs made up from a series of crushed limestone body-chamber of different sizes and perhaps belonging to different species” (1964, p. 350). However, specimens recently discovered at La Bédoule in levels of the *D. weissi* Zone (Ropolo et al., in print) do correspond to the original illustration of *D. consobrinus* by d’Orbigny, which may not be a synthetograph at all.

Bogdanova (1979, pl. 2, fig. 3, 4) depicted under the name *D. consobrinus* some specimens from the *D. weissi* Zone of the Turkmenistan that she quotes (1979, fig. 1) also from the *D. tuarkyricus* Zone. However, Bogdanova’s specimens cannot be matched with both the original illustration and the lectotype of *D. consobrinus* (designated by Casey, 1964, p. 352, fig. 124 b), which correspond to larger forms with coarser ribs. Recently (Avram, 1999), the Turkmenian specimens were included in the species *Deshayesites bogdanovae* Avram.

**Stratigraphical implications.**

The fauna from La Bédoule described in this paper can be ascribed easily to the *D. tuarkyricus* Zone due to the occurrence of species originally reported from Turkmenistan. So far, the Barremian-Aptian boundary defined on the basis of the Turkmenian ammonite biozones cannot be correlated with the boundary defined in other areas, particularly in the Mediterranean region, where virtually no sections with a continuous ammonite succession are known. In the Angles-Rarréme area (southern France) the *D. tuarkyricus* Zone was recognized by Delanoy (1995), but it is poorly represented and the ammonite record from the levels of the Barremian - Aptian transition is not as complete as in

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**PLATE 7**

Fig. 1 - *Deshayesites bedouliensis* n. sp., evolute morphotype, spec. BW 055. Holotype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 2 - *Deshayesites aff. normani* Casey, spec. BW 013. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 3 - *Deshayesites cf. planicostatus* Bogdanova, spec. BW 005. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

The arrow indicates the beginning of the body chamber.

**PLATE 8**

Fig. 1 - *Deshayesites bedouliensis* n. sp., evolute morphotype, specimen BW 054. Paratype. Le Brigadan section, *Deshayesites tuarkyricus* Zone, x1.

Fig. 2-4 - *Deshayesites* n. sp. A: 2, spec. BW 023; 3, spec. BW 024; 4, spec. BW 025, Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

The arrow indicates the beginning of the body chamber.

**PLATE 9**

Fig. 1 - *Deshayesites aff. consobrinus* (d’Orbigny), spec. BW 066. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 2-4 - *Deshayesites* sp. B: 2, spec. BW 001; 3, spec. BW 080; 4, spec. BW 081. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

The arrow indicates the beginning of the body chamber.
the La Bédoule area. On the other hand, the presence of the D. tuarkyricus Zone in southern Spain was inferred on the basis of rare specimens (Aguado et al., 1997).

This study documents for the first time that several species originally described from Turkmenia were recognized in a Mediterranean section. Therefore, the La Bédoule area may now represent a type-area for the Barremian - Aiptian boundary in the Mediterranean area.

According to the Cephalopod Working Group of the IGCP Projects 262 and 362, which adopted the Turkmenian Aptian ammonite zonal sequence as a "standard" for the Mediterranean area (Hoedemaeker & Bulot, 1990; Hoedemaeker & Company, 1993; Hoedemaeker & Cecca, 1995), the D. tuarkyricus Zone is the first ammonite Zone of the Aiptian. Therefore, the lower boundary of the Aiptian in the Mediterranean area is usually drawn at the FO of the genus Deshayesites (Delanoy, 1995; Erba, 1996; Aguado et al., 1997; Delanoy et al., 1997; Moullade et al., 1998; Ropolo & Gonnet, 1999; Ropolo et al., in print).

However, the FO of the genus Prodeshayesites was taken by Birkelund et al. (1983) to mark the base of the Aiptian in both northwest Europe and southeast France. According to Birkelund et al. (1983) and Rawson (1983) this decision was strengthened by the supposed occurrence of Prodeshayesites at La Bédoule (Busnardo, 1984) together with typically Tethyan genera, thus providing a link between Boreal and Tethyan faunas. It is worth noting that in southern England and northern Germany the occurrence of Prodeshayesites is reported below the first occurrence of the genus Deshayesites (Rawson, 1983).

Without any palaeontological description and illustration, Busnardo (1984) reported from La Bédoule supposed representatives of Prodeshayesites from levels below the Pseudocioceras-bearing beds, which he included in his Pseudocioceras coquandi Zone and which he erroneously ascribed to the basal Aiptian. According to Delanoy et al. (1997, p. 598), representatives of the genus Martelites (which characterize the uppermost Barremian M. sarasini Zone) were confused with Prodeshayesites. Furthermore, subsequent research in the La Bédoule area (Ropolo & Gonnet, 1999; Ropolo et al., in print; Gonnet et al., in prep.) demonstrated the total absence of the genus Prodeshayesites in this area, since all identified deshayesitids belong to the genus Deshayesites Kasanskaya.

The problem of correlating the Boreal Prodeshayesites levels (i.e. the Prodeshayesites fassicostatus Zone, recognized in southern England, and the time-equivalent Prodeshayesites tenuicostatus Zone, recognized in northern Germany) with the D. tuarkyricus Zone remains unresolved. In fact, this genus is absent in La Bédoule and in other Mediterranean areas, despite citations (Delanoy, 1991; Cecca et al., 1995) that are now considered erroneous (Delanoy, 1995; Aguado et al., 1997). Prodeshayesites is absent also in Turkmenistan (Bogdanova, 1971; Bogdanova & Tovbina, 1995). Kemper (1995) considered Prodeshayesites a synonym of Deshayesites and stressed the affinities of some Turkmenian specimens, interpreted by Bogdanova (1979) as D. consobrinus (d'Orbigny), now included in D. bogdanovae Avram, with the group of Deshayesites bodei (Koenen). As the specimens illustrated by Bogdanova were collected in the D. weissi Zone (though she also quotes specimens from the D. tuarkyricus Zone, without illustration), Kemper's opinion could have dramatic biostratigraphic consequences if confirmed by further studies. In fact Casey (1964) included D. bodei in the genus Prodeshayesites, whose FAD should define the base of the Aiptian (Birkelund et al., 1983; Rawson, 1983; Erba, 1996). On the other hand, Bogdanova (1979 and pers. comm. February 1999) also considered Prodeshayesites a possible synonym of Deshayesites but she correlated the D. tuarkyricus Zone with the English Prodeshayesites fassicostatus Zone (Bogdanova & Tovbina, 1995). Further studies are urgently needed to resolve this problem.

The appearance of the genus Deshayesites in the beds that directly overlie the last Pseudocioceras-bearing bed, is used to draw the base of the Aiptian at La Bédoule. In agreement with the above-mentioned zonation defined by the Cephalopod Working Group of IGCP Projects 262 and 362, the FAD of the genus Deshayesites should be taken to mark the base of the Aiptian in the Mediterranean area.

Acknowledgements.

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