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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. oglanlensis* 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.

Riassunto. Nuove ricerche paleontologico-biostratigrafiche in livelli direttamente sovrapposti all'ultimo strato a *Pseudocrioceras* a La Bédoule (SE della Francia), l'area stratotipica del Beduliano (Aptiano inferiore), hanno portato alla scoperta di una fauna caratterizzata da macroconchi del genere *Deshayesites* mai descritti precedentemente ed inclusi in *Deshayesites bedouliensis* n. sp. e in *D.* aff. *consobrinus* (d'Orbigny). Queste forme sono associate alle specie *Deshayesites antiquus* Bogdanova, *D. oglanlensis* Bogdanova, *D.* cf. *weissiformis* Bogdanova, *D.* aff. *weissiformis* Bogdanova in Delanoy, *D.* cf. *planicostatus* Bogdanova, *D.* aff. *normani* Casey. Queste ammoniti caratterizzano la Zona a *Deshayesites tuarkyricus* che indica la base dell'Aptiano. Questa Zona fu definita in Turkmenistan ma il suo riconoscimento nella Tetide Mediterranea è confermato dal presente lavoro. Contrariamente a quanto citato in lavori precedenti, il genere *Prodeshayesites* (che precede *Deshayesites* in Germania settentrionale ed in Inghilterra meridionale), la cui FAD fu scelta per tracciare la base dell'Aptiano, è assente a La Bédoule. *Prodeshayesites* è assente anche in Turkmenistan e nelle altre località mediterranee. In queste ultime la base dell'Aptiano viene tracciata in base alla FAD di rappresentanti del genere *Deshayesites*.

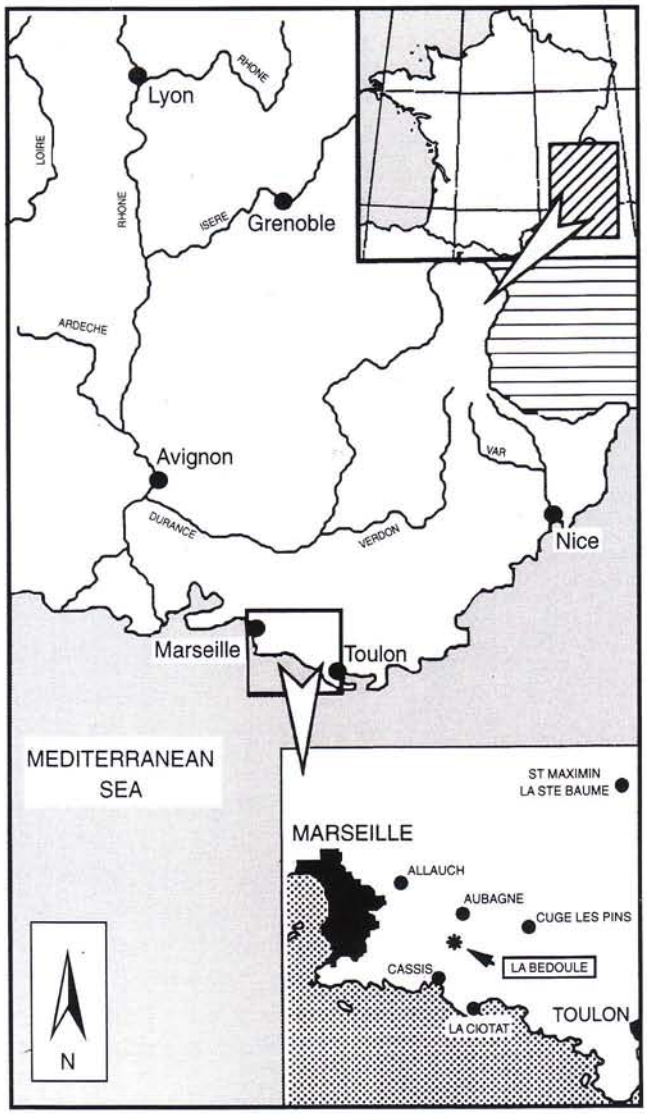

Fig. 1 - Geographical location of the La Bédoule area.

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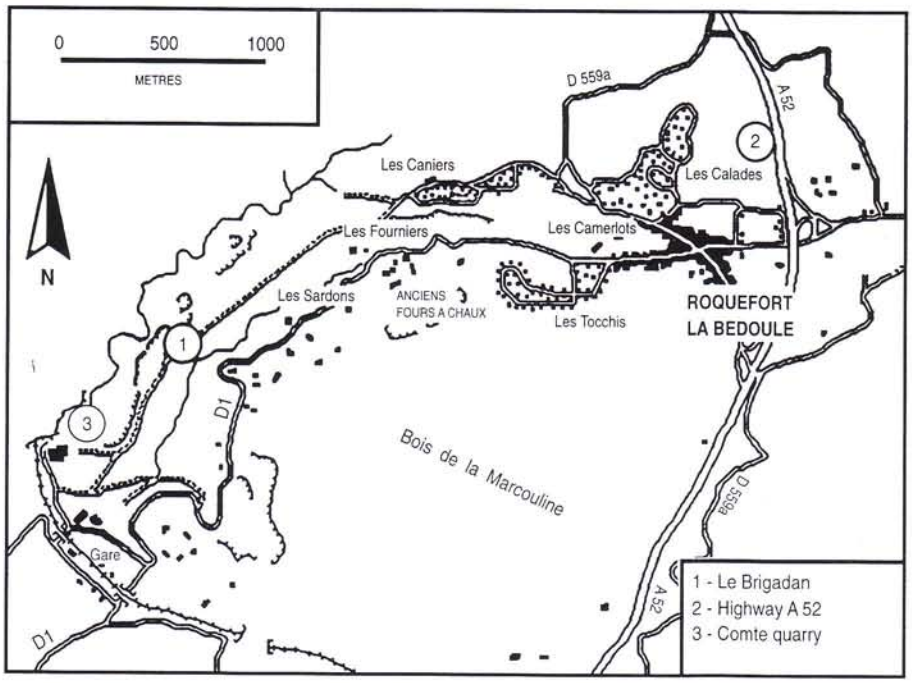


Fig. 2 - Location of the sections mentioned in the text.

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 print; 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 tuarkyricus* Zone.

The fauna of the earliest Aptian *Deshayesites tuarkyricus* 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. tuarkyricus* 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).
- small Deshayesitidae: *Deshayesites antiquus* Bogdanova, *D.* cf. *planicostatus* Bogdanova, *D. oglanlensis* Bogdanova, *D.* cf. *weissiformis* Bogdanova, *D.* aff. *weissiformis* Bogdanova in Delanoy, 1995, *D.* aff. *normani* Casey, *D.* n. sp. A and *D.* n. sp. B;
- *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).

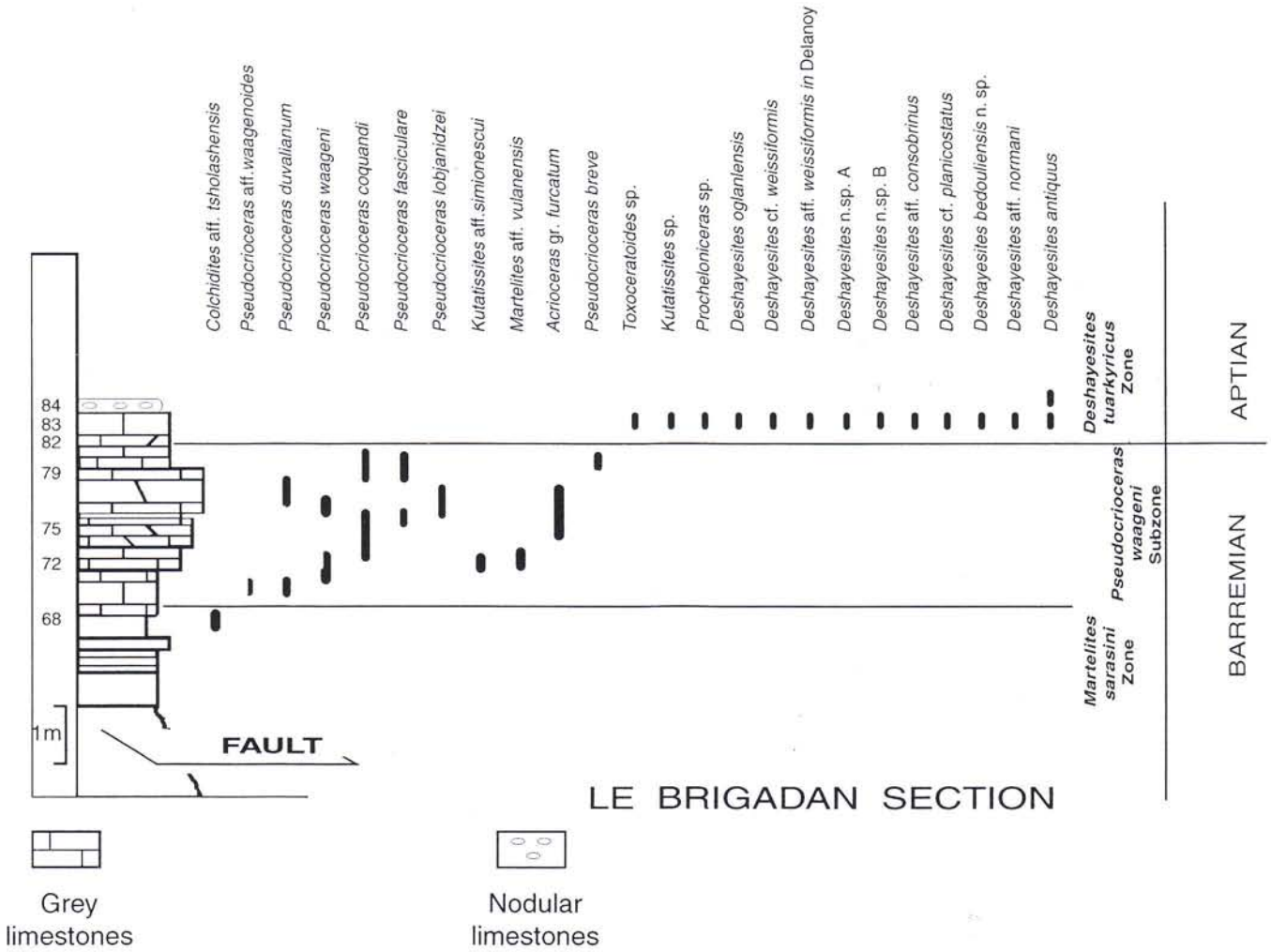


Fig. 3 - Stratigraphic log of the Le Brigadan section and vertical distribution of the ammonites species recognized.

Some of the ammonite species (*Deshayesites antiquus*, *D.* aff. *weissiformis*, *D.* cf. *planicostatus*, *D. oglanlensis*) characterize the *Deshayesites tuarkyricus* 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 D e s h a y e s i t a c e a e Stoyanow, 1949
Family D e s h a y e s i t i d a e Stoyanow, 1949
Subfamily D e s h a y e s i t i n a e 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.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW015	33	12(0.44)	-	7(0.26)	-	29	
BW051	27	14(0.42)	6.5(0.2)	90.27)	-	~26	

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; Pl. 5, 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, 071, 074, 079, RG 1456.

Type-locality: Le Brigadan, near La Bédoule.

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

Material: BW 006, 010, 052, 053, 054, 055, 056, 057, 058, 059, 060, 061, 062, 063, 067, 068, 069, 070, 071, 072, 073, 074, 075, 076, 077, 079, RG 1456.

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 periumbilical 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 preceeding one; in this morphotype the umbilical wall tends to disappear and the shell loses its discoidal aspect at the end of the growth.

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 oglanlensis* 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.

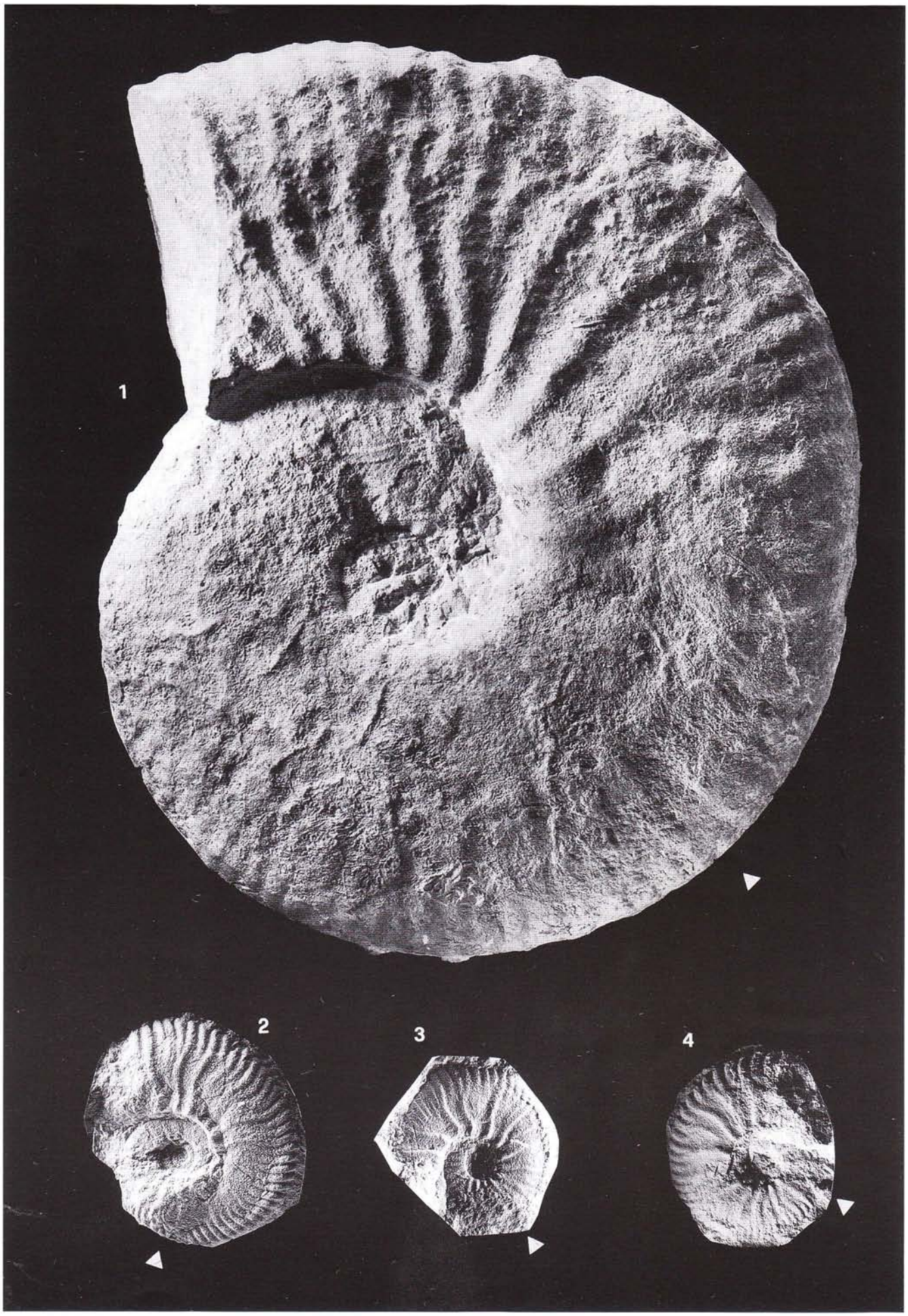
The arrow indicates the beginning of the body chamber.

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.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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 intercalatory ribs start at different heights. Ribs show a very slight adoral convexity on the venter.

Dimensions of the specimens included in the "evolute morphotype".

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
RG 1456	225						~165
	at 216	71 (0.33)	45 (0.21)	80 (0.37)	0.56	~36	
	at 168	70 (0.42)	-	46 (0.27)	-	28	
BW 006	114.5	53 (0.46)	~22 (0.19)	27.5 (0.24)	0.415	38	n
	at 78	39 (0.50)	~17 (0.22)	15 (0.19)	0.435	-	
BW 054	162	52 (0.32)	26.5 (0.16)	58 (0.36)	0.51	35	109
BW 055	179	58 (0.32)	35 (0.195)	60 (0.335)	0.60	~38	113
BW 056	182	-	-	-	-	-	~112
	at 154	60 (0.39)	-	~42 (0.27)	-	-	
	at 138	60 (0.43)	-	~28 (0.20)	-	-	
BW 061	~160	-	-	-	-	-	~112
	at 152	52.5 (0.345)	~26 (0.17)	~46.5 (0.305)	0.495	-	
BW 063	178	61.5 (0.345)	~30 (0.17)	58 (0.325)	0.49	38	~108
	at 122	59 (0.48)	-	30 (0.245)	-	~38	
BW 067	~165	48 (0.29)	-	63 (0.38)	-	36	127
	at 127	55 (0.43)	32 (0.25)	37 (0.29)	0.58	37	
BW 068	~153.5	50 (0.325)	33 (0.21)	57.5 (0.37)	0.60	33	~110
	at 117	49 (0.42)	27 (0.23)	34 (0.29)	0.55	-	
BW 069	~181.5	56.5 (0.31)	-	67.5 (0.37)	-	-	~136
	at 164.5	60 (0.36)	37 (0.22)	49 (0.30)	0.62	37	
BW 070	142	47 (0.33)	24 (0.17)	53 (0.37)	0.51	38	~100
	at 141	48 (0.34)	24 (0.17)	51 (0.36)	0.50	32	
BW 074	140	43.5 (0.31)	25 (0.18)	48 (0.34)	0.57	32	-
	at 105	51.5	-	24.5 (0.23)	-	-	

Dimensions of specimens included in the "involute morphotype"

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW 052	~110	-	-	-	-	-	n
	at 97	50 (0.515)	-	17 (0.175)	-	41	
BW 053	~160	-	-	-	-	-	114
	at 114.5	55 (0.48)	27 (0.235)	24 (0.21)	0.49	44	
BW 057	~168	51.5 (0.31)	29 (0.17)	-	0.56	-	110
	at 161	50.5 (0.31)	26 (0.16)	55 (0.34)	0.51	-	
	at 131	54.5 (0.42)	25 (0.19)	32 (0.24)	0.46	-	
BW 058	168	~57 (0.34)	-	54.5 (0.32)	-	-	120
	at 120	60.5 (0.50)	-	20.5 (0.17)	-	-	
BW 062	~205	-	-	-	-	-	144
	at 195	74 (0.38)	40 (0.205)	~53 (0.27)	0.54	-	
	at 144	67 (0.465)	-	34 (0.24)	-	-	
BW 071	114	51.5 (0.45)	24 (0.21)	24 (0.21)	0.46	50	111
	at 85	47.5 (0.56)	21.5 (0.25)	14 (0.16)	0.45	-	
BW 073	~122	56 (0.46)	~28 (0.23)	30 (0.245)	~0.50	-	~120
	at ~88	~40 (0.45)	-	22 (0.25)	-	30	
BW 075	131	66 (0.50)	-	~25 (0.19)	-	-	n
	at 98	49 (0.50)	23 (0.23)	20 (0.20)	0.47	-	

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'Orbigny's original illustration shows (or, following Casey, was intended to show) an ammonite with strong and

PLATE 4

Deshayesites bedouliensis n. sp., involute morphotype, spec. BW 062. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1. The arrow indicates the beginning of the body chamber.

PLATE 5

Fig. 1 - *Deshayesites bedouliensis* n. sp., involute morphotype, spec. BW 071. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 2 - *Deshayesites bedouliensis* n. sp., involute morphotype, spec. BW 053. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.1. The preserved portion of body chamber is crushed and deformed.

The arrow indicates the beginning of the body chamber.

PLATE 6

Fig. 1 - *Deshayesites bedouliensis* n. sp., involute morphotype, spec. BW 063. Paratype. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1. Crushed Phragmocone phragmocone crushed and slightly deformed body chamber slightly deformed.

Fig. 2, 3 - *Deshayesites* aff. *weissiformis* Bogdanova in Delanoy, 1995: 2, spec. BW 022; 3, spec. BW 003. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

Fig. 4 - *Deshayesites* cf. *weissiformis* Bogdanova, spec. 020. Le Brigadan section, Lower Aptian, *Deshayesites tuarkyricus* Zone, x1.

The arrow indicates the beginning of the body chamber.


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BW 063
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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., p. 136, 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 & Tavera, 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.

Dimensions.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW002	~40	16 (0.40)	-	10.5 (0.26)	-	33	~19
BW004	~34	~11.5 (0.34)	-	8 (0.235)	-	29	~18
BW007	~34	13 (0.38)	-	8 (0.235)	-	~30	~18
BW011a	~35 at 28	- ~13 (0.46)	- -	- 7 (0.25)	- -	- -	~18
BW050	42	20 (0.48)	-	9 (0.21)	-	27	~20

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 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.

Description. Involute, discoidal shells with rounded flanks. The ornamentation is rather strong, consisting of sinuous biplicate ribs and intercalatory ribs which are generally bundled, springing from gentle thickenings in the lower fourth of the flank or close to the umbilical edge. The point of branching of the biplicate ribs lies slightly above the mid-flank. Intercalatory ribs stop at mid-flank.

Dimensions.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW003	32.5	~13 (0.40)	-	~8 (0.25)	-	34	-
BW022	39	20 (0.51)	-	5	-	39	n

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.

Deshayesites cf. **weissiformis** Bogdanova, 1983

pl. 6, fig. 4

Material: BW 020.

Description and discussion. One slightly crushed fragment of a moderately evolute shell. The ornamentation consists of numerous, fine, falcoid, bundled ribs and intercalatory ribs. The ribs spring from periumbilical bullae and bifurcate above the mid-flank.

Our specimen resembles one of the type-specimens illustrated by Bogdanova (1983), i.e. that of pl. 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 periumbilical bullae.

Deshayesites aff. **normani** Casey, 1964

Pl. 7, Fig. 2

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

Pl. 7, Fig. 3

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 periumbilical edge. The secondary ribs are slightly thickened and flattened. All ribs cross the venter describing a convexity towards the aperture.

Dimensions.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW005	38	16 (0.42)	-	11 (0.29)	-	~28	~16

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 periumbilical bullae with those of the type-specimens of *D. planicostatus*.

Deshayesites n. sp. A

Pl. 8, Fig. 2-4

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 periumbilical bullae; there is no true umbilical edge. The ornamentation consists of bundles of ribs springing from strong periumbilical 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.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW023	57	-	-	-	-	-	-
	at 53	21 (0.39)	-	16 (0.30)	-	-	
	at ~ 40	-	-	-	-	30	
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

Pl. 9, Fig. 2-4

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.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW001	~41	16.5 (0.40)	-	11.5 (0.28)	-	40	-

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.

Specimen	D	Wh	Wb	Uw	Wb/Wh	K	Ph
BW066	~200 at 188	- 68 (0.36)	- 35 (0.19)	- 66 (0.35)	- 0.51	- 30	~135

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, fig. 1, 2) 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-Barrème 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

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

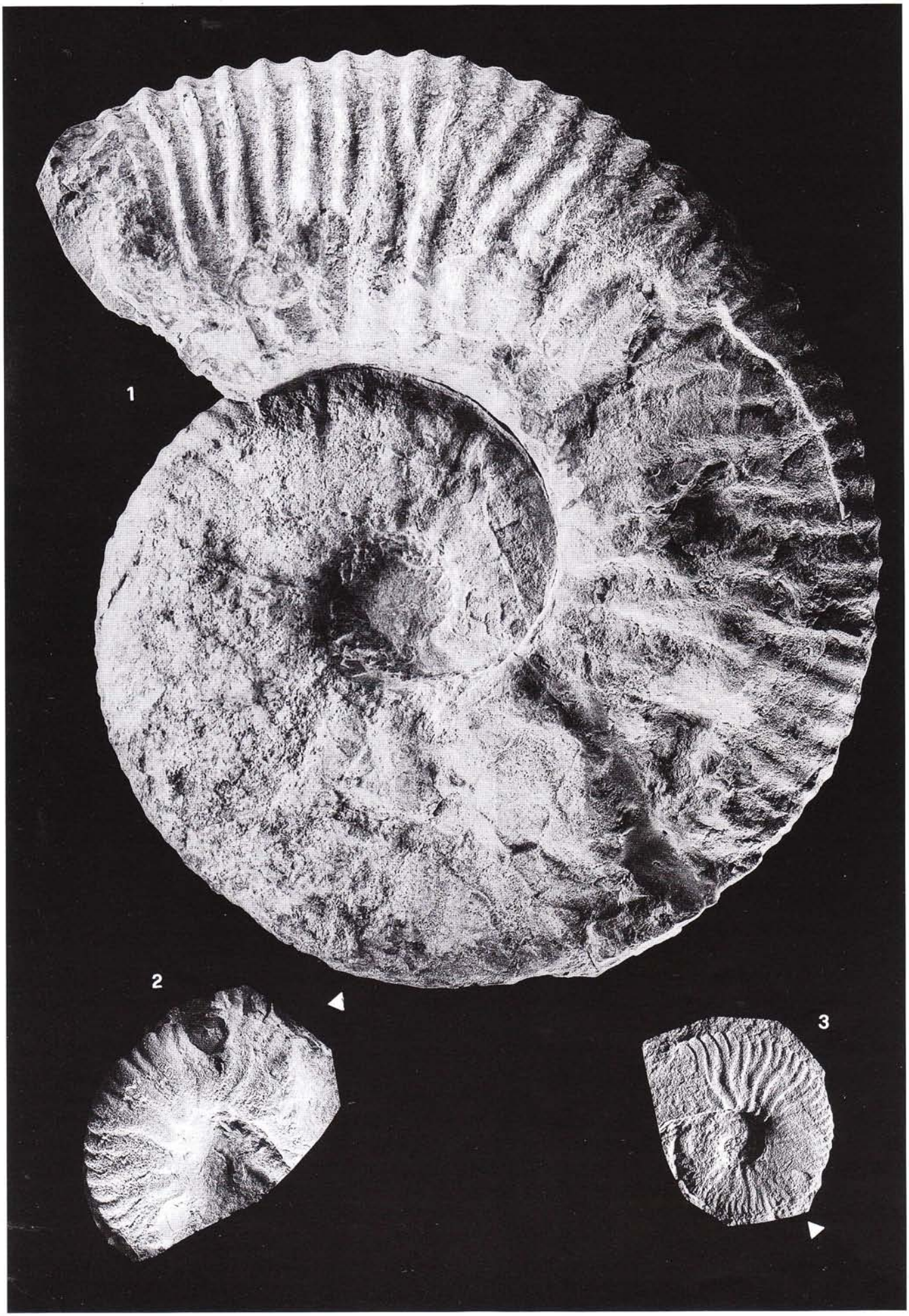
The arrow indicates the beginning of the body chamber.

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.


1
2
3


1
2
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1
BW 066
2
3
4

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 Turkmenistan were recognized in a Mediterranean section. Therefore, the La Bédoule area may now represent a type-area for the Barremian - Aptian 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 Aptian. Therefore, the lower boundary of the Aptian 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 Aptian 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 *Pseudocrioceras*-bearing beds, which he included in his *Pseudocrioceras coquandi* Zone and which he erroneously ascribed to the basal Aptian. 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* Kasansky.

The problem of correlating the Boreal *Prodeshayesites* levels (i.e. the *Prodeshayesites fissicostatus* 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 Aptian (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 fissicostatus* 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 *Pseudocrioceras*-bearing bed, is used to draw the base of the Aptian 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 Aptian in the Mediterranean area.

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