The Early Aptian (Early Cretaceous) ammonites from the Aralar Mountains, Basque-Cantabrian Basin, Northern Spain

Seyed Naser RAISOSSADAT [1]

Abstract: The Aralar Mountains located in northern Spain exposes a 983-m-thick succession of sediments of Early Aptian age. The lithological succession evolves from lutites, marls, and calcarenites of the Errenaga Formation to rudist micritic limestones of the Sarastarri Formation, and finally marls, lutites, and sandstones of the Lareo Formation. Based on ammonite assemblage faunas, the *Deshayesites oglanlensis*, *D. weissi*, *D. deshayesi*, and *Dufrenoyia furcata* biozones have been identified. A transition between the *deshayesi* and *furcata* zones with the co-occurrence of the ammonite genera *Deshayesites* and *Dufrenoyia* is described in the Aralar succession and is currently unique. The ammonites are described here and correlations are made with other Tethyan regions.

Key Words: Ammonite; Aptian; biozonation; Basque Country; Spain; Tethys.

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Résumé : ***Les ammonites de l'Aptien inférieur (Crétacé inférieur) des Monts Aralar, Bassin basco-cantabrique, Espagne septentrionale*.-** Le massif d'Aralar, situé dans le nord de l'Espagne, montre sur 983 m d'épaisseur une succession de sédiments d'âge Aptien inférieur. La succession lithologique débute par les lutites, puis les marnes et les calcarénites de la Formation Errenaga, auxquelles succèdent les calcaires micritiques à rudistes de la Formation Sarastarri, et enfin les marnes, puis les lutites et les grès de la Formation Lareo. Basées sur des assemblages d'ammonites, les biozones à *Deshayesites oglanlensis*, *D. weissi*, *D. deshayesi* et *Dufrenoyia furcata* ont été identifiées. La transition entre la Zone à *deshayesi* et celle à *furcata* observée ici est un cas unique dans l'état actuel des connaissances, notamment en raison de la cooccurrence d'ammonites des genres *Deshayesites* et *Dufrenoyia*. Ces ammonites sont décrites et les corrélations avec d'autres régions du domaine téthysien sont présentées.

Mots-Clefs : Ammonite ; Aptien ; biozonation ; Pays Basque ; Espagne ; Téthys.

1. Introduction

The Basque-Cantabrian Basin is located in north east Spain (Fig. 1). It is a peri-cratonic rift basin related to the opening of the Bay of Biscay (MONTADERT *et alii*, 1974). The opening was dated in the Early Aptian (MONTADERT *et alii*, 1979; THINON *et alii,* 2002), and more recently in the Early Barremian (SIBUET *et alii*, 2004). Four main subsidence pulses have been detected in the Basque-Cantabrian region during the Aptian and Albian (GARCÍA-MONDÉJAR *et alii*, 2005). The very thick succession of sediments in the Aralar Mountains span in age from the Barremian-Aptian boundary to the top of the Early Aptian and has provided an important ammonite record which underpins the geochemical results and interpretations of OAE-1a obtained in this succession (GARCÍA-MONDÉJAR *et alii,* 2009).

The Aptian succession in the Aralar Mountains (Fig. 1) has been described most recently by GARCÍA-MONDÉJAR *et alii* (2009). In this region, the succession consists of the predominantly siliciclastic sedimentation of the Errenaga and Lareo formations with a major intercalated limestone, the Sarastarri Limestone rich in rudists, orbitolinids and corals (LERTXUNDI & GARCÍA-MONDÉJAR, 1997; MILLÁN *et alii*, 2005, 2007; GARCÍA-MONDÉJAR *et alii*, 2009) (Fig. 2).

The outcrop of these sediments extends from Iribas in the east to Ataun in the west (Fig. 2) and they have been described in detail by GARCÍA-MONDÉJAR *et alii* (2009). Since these two formations were reported to contain ammonites in previous studies, a careful search was made by the team led by Professor J. GARCÍA-MONDÉJAR of the Universidad del Pais Vasco, Bilbao, Spain, which resulted in the gathering of a large amount of new material. Although most of the specimens are crushed, they have permitted the biozonation of these formations based on the ammonite occurrences. The present paper, therefore, presents a systematic description of these Early Aptian ammonite faunas together with their biozonation.

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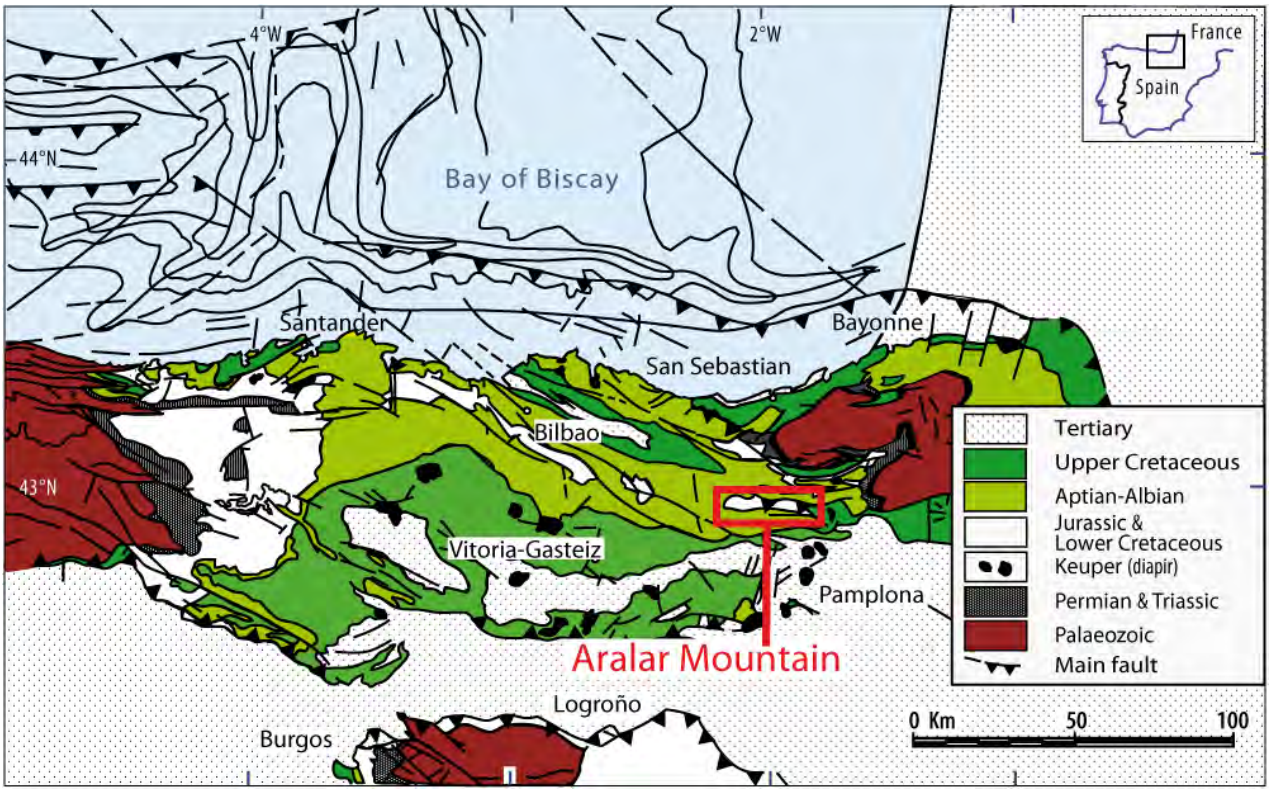


Figure 1: Location of the Aralar Mountain in the western part of the Basque-Cantabrian Basin in the northern margin of Iberia and south of the Bay of Biscay (modified after García-Mondéjar *et alii*, 2009).

Apart from some records of the presence of *Deshayesites deshayesi* Leymerie in localized areas (*e.g.*, Aralar: Durvenois *et alii*, 1972; Floquet & Rat, 1975), the only important description of Early Aptian ammonites was made in the Cuchía (Santander) region in the northwestern part of the basin (Collignon *et alii*, 1979). These authors identified several species of *Prodeshayesites*, *Deshayesites*, *Cheloniceras* and *Vectisites* corresponding to the four zones of the Early Aptian in England (Casey *et alii*, 1998) (Table 1).

Martínez (1982) in Lérida, Moreno-Bedmar (2007) and Moreno-Bedmar *et alii* (2009) in Barcelona, and Aguado *et alii* (1997) in the Betic Cordillera describe Early Aptian Iberian ammonite occurrences outside of the present area. Although ammonite occurrences are relatively few in the Aralar succession and restricted to certain horizons, they are sufficient to permit a more precise ammonite biozonation to be made of the Early Aptian in this region than has been possible hitherto.

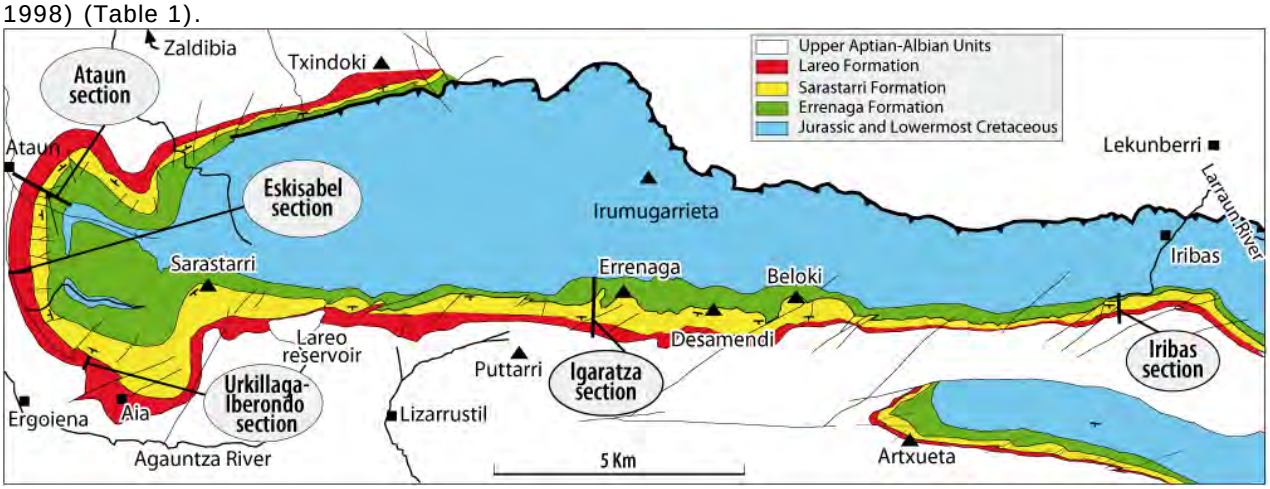


Figure 2: Geological map of the Aralar Mountain showing the Errenaga, Sarastarri and Lareo formations, and sections of Iribas, Igaratza, Urkillaga-Iberondo, Eskisabel and Ataun (modified after García-Mondéjar *et alii*, 2009).

<table>
<tr><th>Age</th><th>Substage</th><th>CASEY, 1961c; HANCOCK, 1991; CASEY et alii, 1998 (SE England)</th><th>KEMPER, 1973; RAWSON, 1983 (North Germany / England)</th><th colspan="2">BUSNARDO, 1984; DELANOY, 1997; ROPOLO et alii, 1999, 2000 (France)</th><th>HOEDEMAEKER et alii, 2003; REBOULET et alii, 2009 (Mediterranean Region)</th><th>KOTETSHIVILI et alii, 2000 (Caucasus)</th></tr>
<tr><td rowspan="6">Aptian</td><td rowspan="2">Late</td><td rowspan="2">Cheloniceras (Epicheloniceras) martinioides</td><td>Epicheloniceras tschernyschewi</td><td>Middle</td><td rowspan="2">C. (Epicheloniceras) martinioides</td><td rowspan="2">C. (Epicheloniceras) subnodosocostatum/ C. (Epicheloniceras) martini</td><td rowspan="2">C. (Epicheloniceras) subnodosocostatum</td></tr>
<tr><td>Tropaeum drewi</td><td></td></tr>
<tr><td rowspan="4">Early</td><td>Tropaeum bowerbanki</td><td>Tropaeum bowerbanki</td><td rowspan="4">Early</td><td>T. bowerbanki / D. furcata</td><td>Dufrenoyia furcata</td><td>Dufrenoyia furcata</td></tr>
<tr><td>Deshayesites deshayesi</td><td rowspan="2">Deshayesites deshayesi</td><td>Deshayesites deshayesi</td><td>Deshayesites deshayesi</td><td rowspan="2">Deshayesites deshayesi</td></tr>
<tr><td>Deshayesites forbesi</td><td>Deshayesites weissi</td><td>Deshayesites weissi</td></tr>
<tr><td>Prodeshayesites fissicostatus</td><td>Prodeshayesites fissicostatus</td><td>Deshayesites tuarkyricus</td><td>Deshayesites oglanlensis</td><td>D. weissi-procheloniceras albrechti-austria</td></tr>
<tr><td rowspan="2">Barrem.</td><td rowspan="2">Late</td><td rowspan="2"></td><td rowspan="2">Parancyloceras bidentatum & Parancyloceras scalare</td><td colspan="2">Pesudocrioceras waagenoides</td><td>Pesudocrioceras waagenoides</td><td>Colchidites securiformis</td></tr>
<tr><td colspan="2">Martelites sarasini</td><td>Martelites sarasini</td><td></td></tr>
</table>

Table 1: Correlation chart of the Early Aptian biozones in the Tethyan and Boreal Realm.

2. Outline stratigraphy

The top of the non-marine Wealden series, which rests upon an Upper Jurassic succession, is overlain by marls with ammonites including *Valdedorsella* sp. of latest Barremian age. These sediments in turn underlie an ammonite and orbitolinid-rich marine Early Aptian succession. The detailed stratigraphical succession is described by GARCÍA-MONDÉJAR *et alii* (2009) and is shown in Figs. 3 - 4.

a. Errenaga Formation

The Errenaga Formation comprises shales, marls, siltstones, sandstones and marly limestones. There are significant thickness variations in an E-W transect, from Iribas (69 m) to Igaratza (200 m) and Ataun (482 m) (Fig. 3). There is no lateral continuity of exposure; thus correlation of the three sections has been based on the lithologic similarity of subunits, controlled sedimentological changes, vertical arrangement of facies associations, TOC curve trends of selected intervals and ammonite occurrences (GARCÍA-MONDÉJAR *et alii*, 2009).

Various fossiliferous horizons containing ammonites of the *Deshayesites oglanlensis*, *Deshayesites weissi*, *Deshayesites deshayesi* zones and *Deshayesites deshayesi* - *Dufrenoyia furcata* transition zones of the Early Aptian have been identified and correlated (Fig. 4).

b. Sarastarri Formation

The Sarastarri Formation consists of intercalation of limestones, marls, and marly limestones that extend at least 21.5 km from east (Iribas section) to west (Ataun section) and thicken progressively westward, from Iribas (53 m), to Igaratza (150 m) and Ataun (178 m) (Fig. 3). The limestones stand as a prominent mappable feature in the field and thus provides an important marker in the determination of the tectonic structures of the Sierra de Aralar. Although no ammonites have been found in this Formation, it is dated as Early Aptian *deshayesi-furcata* zones transition on account of the faunas in the uppermost Errenaga Formation below and the Lareo Formation above. The Sarastarri limestones indicate a stepped drowning in two different phases in the *Deshayesites deshayesi-Dufrenoyia furcata* transition Zone (MILLÁN *et alii,* 2007). In the lower part of the immediately overlying Lareo Formation at Ataun, there is a specimen of *Dufrenoyia* sp. already of basal *furcata* Zone age.

At Igaratza, assemblage 9 in the basal Lareo Formation also contains *Deshayesites*, and specimen LEIZ-1 is a *Dufrenoyia* cf. *lurensis* KILIAN. Thus, the Sarastarri Limestone marks a pause in terrigenous sedimentation in the *deshayesi-furcata* zones transitional interval. At Iribas, the Sarastarri Limestone is overlain directly by the Late Aptian San Gregorio-Artxueta Units (Fig. 3). The Formation terminates in an areally extensive 20 m thick micritic limestone unit containing corals and rudists (Gorrin-txabola). It is capped by an erosional surface overlain by the Lareo Formation.

c. Lareo Formation

The Lareo Formation is dated with ammonites initially as still within the *Deshayesites deshayesi-Dufrenoyia furcata* transitional Zone and subsequently in the *D. furcata* Zone. This unit shows a variety of facies and it wedges out from west to east (GARCÍA-MONDÉJAR *et alii*, 2009). The Lareo Formation is overlain by the Upper Aptian San Gregorio Unit which cuts down to the Sarastarri Limestone at Iribas (Fig. 3).

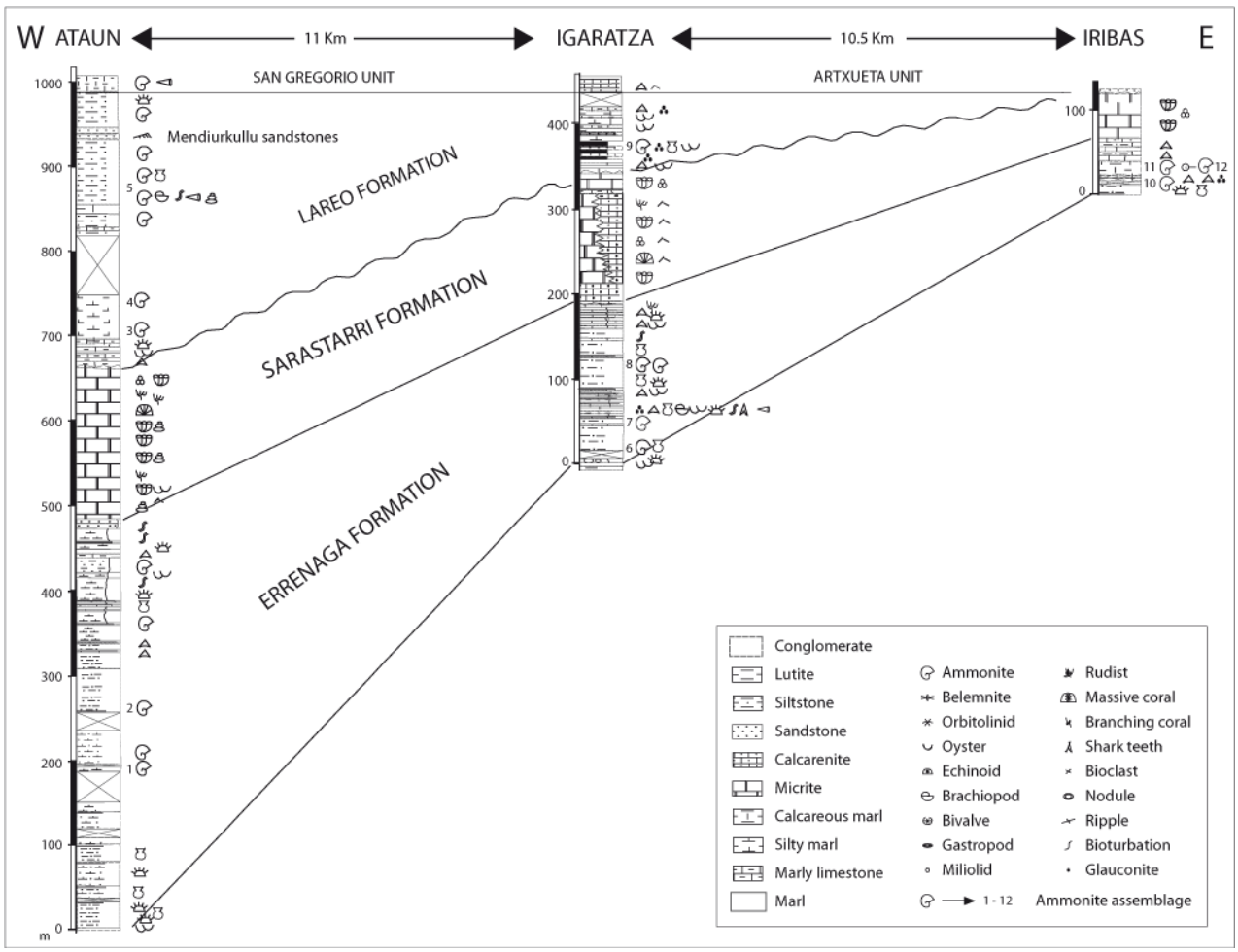


Figure 3: Lithostratigraphic correlation chart of the Lower Aptian sediments of the Aralar, sections of Iribas, Igaratza and Ataun, with indication of the units and ammonite assemblages described in the text.

d. Upper Aptian formations

The units overlying the Early Aptian succession comprise the Upper Aptian San Gregorio Formation in the west, made up of marly limestones and marls, and the Artxueta Unit in the east, made up of shallow-water Urgonian limestones (FLOQUET & RAT, 1975; LERTXUNDI, 1997) (Fig. 3). They make up a broad carbonate inner ramp (Artxueta) grading downdip to the correspondent outer ramp (San Gregorio).

3. Systematic description

The present study stems from the systematic sampling of the Lower Aptian succession in the Aralar region. Every genus and species which have been found are described briefly, and their occurrence and distribution in the stratigraphical column of the study area is discussed where appropriate. There are some genera or species new to the basin. The classification follows that given in the Treatise on Invertebrate Palaeontology, part L (WRIGHT *et alii*, 1996).

Shell measurements (in millimeters) are given in the following order: Diameter (D), whorl height (WH), ratio of whorl height to diameter (WH/D), whorl thickness (WT), ratio of whorl thickness to diameter (WT/D), umbilical width (U), ratio of umbilical width to diameter (U/D), primary ribs in the umbilical area (PR) and all ribs (primary and secondary) on the ventral side (SR). Because some specimens are incomplete and not all dimensions can be measured, the ratio of whorl thickness to whorl height (WT/WH) is also given.

The following abbreviations are given for localities. ATAN= Ataneta locality, IRIBAS section (Errenaga Formation), AIZMUSU= Aizmusu locality, 2km east of the URKILLAGA-IBERONDO section, Ataun area (Lareo Formation), ER= IGARatZA section (Errenaga Formation). (material collected loose from surface debris], ERG= IGARatZA section (Errenaga Formation). (fauna collected *in situ*), IRI= IRIBAS section (Errenaga Formation), IMA= ATAUN section (Errenaga Formation), NAZ= Nazca Maizagi locality, 2km east of the URKILLAGA-IBERONDO section and 0.5km north of the Aizmusu locality, Ataun area (Lareo Formation), SANGRE= ESKISABEL section, Ataun area (Lareo Formation), URKI= URKILLAGA-IBERONDO section, Ataun area (Lareo Formation), URG = Urgoxo locality, IRIBAS section (Errenaga Formation).

The palaeontological material is housed in the Departamento de Estratigrafía y Paleontología, Universidad del País Vasco, Bilbao

(UPV/EHU) and the assemblage and specimen numbers apply to that institution.

Suborder Ammonitina Hyatt, 1889
Superfamily Haploceratataceae Zittel, 1884
Family Oppeliidae Douville, 1890
Subfamily Aoneceratinae Spath, 1923
Genus *Aconeceras* Hyatt, 1903

Type species: *Ammonites nisus* d'Orbigny, 1841

Generic characters: Involute oxycone with flattened or gently convex sides that narrow above to a hollow microscopically serrated carina or keel. Ventro-lateral shoulders are distinct or broadly rounded; umbilicus with angular rim and low steep wall; flanks almost smooth or bearing sickle-shaped, forwardly inclined striae or faint flattened ribs. Suture line with narrow trifid lateral lobes and tall lateral saddle and many secondary elements declining in regular series to the umbilicus.

Discussion: The separation of some genera of the Aoneceratinae is based on the presence of ribs and denticulation of the keel. However, it seems that this division is not useful in practice (Wright *et alii*, 1996). Thus *Aconeceras*, *Sanmartinoceras*, *Sinzovia*, *Theganoceras* and *Gyaloceras* are grouped as subgenera of *Aconeceras*. The subgenus *Aconeceras s.s.* is known principally by immature (incomplete) shells or nuclei that lack the mouth-borders. Therefore, it is not clear whether lappets and rostrum comparable to those of the subgenus *Sanmartinoceras* occur, of if the edge of its peristome follows the growth-lines as in *Falciferella*.

Occurrence: The genus is recorded from Europe, north east Greenland, Algeria, South Africa, Madagascar, Australia, Argentina, Nepal and Antarctica (subgenus *Theganoceras*) (Wright *et alii*, 1996) and Iran (Raisossadat, 2002).

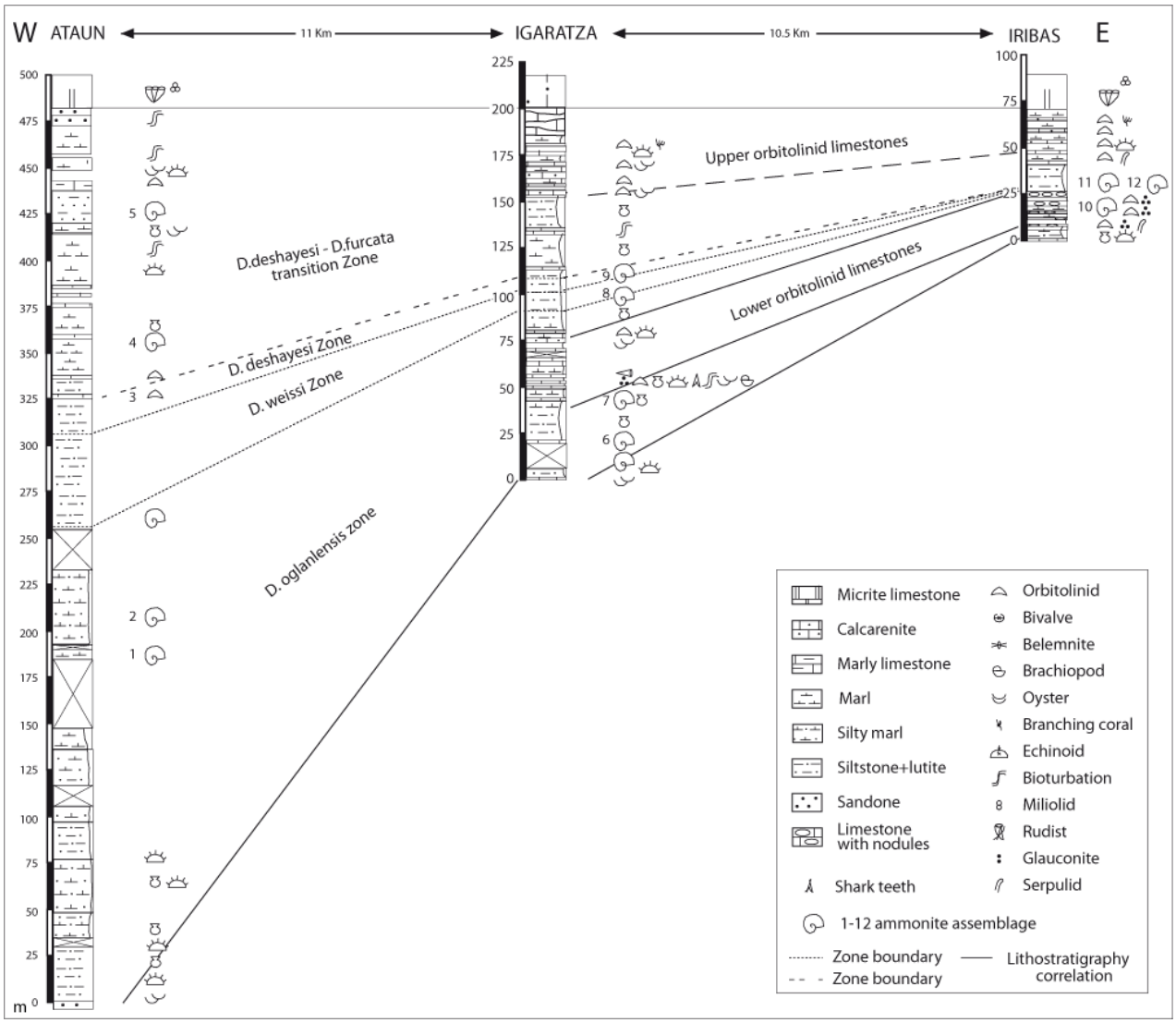


Figure 4: Stratigraphic correlation of the Errenaga Formation from Iribas to Igaratza and Ataun sections. Note the east to west thickening of the unit.

Subgenus *Aconeceras* (*Aconeceras*) Hyatt, 1903
Aconeceras cf. *nisoides* (Sarasin, 1893)

Fig. 5 A

cf. 1893 *Oppelia nisoides* (Sarasin), p. 155, pls. iv-v, fig. 10a-c; text-figs. 3, 5.
cf. 1924 *Oppelia nisoides* (Sarasin): Spath, p. 311, pl. 26, figs. 4a-b; text-fig. B9.
cf. 1958 *Sinzova nisoides* (Sarasin): Sazonova, p. 129-130.
cf. 1961a *Aconeceras nisoides* (Sarasin): Casey, p. 125-128, pl. 26, fig. 3-5; text-fig. 41a-c.
cf. 1995 *Aconeceras nisoides* (Sarasin): Kemper, taf. 8, fig. 4.

Lectotype: Sarasin (1893, pls. iv-v, fig. 10a-c) from the Lower Aptian of the Haute-Marne (collection École des Mines de Paris).

Material: NAZ-6, 7; URKI-1, 2, 3, 4, 5, 6, 8, 9, 10, URKI-C-1

Description: Involute oxycone, whorls high and compressed, sub-rectangular, nearly convex sides, ventral margin with a low keel in middle part, test nearly smooth with trace of fine ribs.

Measurements:

Sample Number	D	WH	WH/D	WT
NAZ-7	21	11.5	0.54	5
URKI-1	15	7	0.46	3
URKI-2	12.5	7	0.56	3
Lectotype	27	13.7	0.51	3.78
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
NAZ-7	0.23		0	0.43
URKI-1	0.2	3	0.2	0.43
URKI-2	0.24	2.1	0.17	0.43
Lectotype	0.14	5.94	0.22	0.27

Discussion: Suture line and rib pattern are diagnostic for the species. *A. nisoides* differs from *A. nisus* by possessing a wider umbilicus and more feeble ornamentation on whorl flanks.

Occurrence: England (Spath, 1924; Casey, 1961a), France (Sarasin, 1893; Roman, 1938), Germany (Stolley, 1907) and Russia (Sazonova, 1958). Casey (1961a, p. 126) also mentioned that the species is reported from Sweden and Zululand.

Distribution: Lower part Nazca Maizagi locality, 2km east of the Urkillaga-Iberondo section and lower part of Urkillaga-Iberondo section, Lareo Formation (Fig. 6).

Aconeceras haugi Sarasin, 1893

Fig. 5 B-C

1893 *Oppelia haugi* Sarasin, p. 156, pl. 4-6, fig. 11a-c.
1961a *Aconeceras* cf. *haugi* (Sarasin): Casey, p. 128, text-fig. 40g-h.
1973 *Aconeceras haugi* (Sarasin): Kemper, p. 42, pl. 2, fig. 4.
1982 *Aconeceras haugi* (Sarasin): Renz, p. 21-22, pl. 1, fig. 14a-b.
1995 *Aconeceras haugi* (Sarasin): Kemper, pl. 2, fig. 4.

Type by monotypy, Sarasin, 1893, p. 145, pls. 4-6, fig. 11a-c from the Aptian of St. Dizier, France (collection École des Mines de Paris).

Material: AIMUSU-2, 3; URKI-11

Description: High whorled, involute, oxycones, whorl section sub-fastigiate, ventro-lateral shoulder rounded but distinct, sides parallel, flattened, keel distinct.

Measurements:

Sample Number	D	WH	WH/D	WT
AIZMUSU-2		6		3
AIZMUSU-3	12	5.5	0.458	3
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
AIZMUSU-2		2.8		0.5
AIZMUSU-3	0.25	3	0.25	0.545

Discussion: *A. haugi* differs from *A. nisus* by possessing ventro-lateral shoulders. According to Renz (1982), *Sanmartinoceras groenlandicum* (see Casey, 1961b, p. 131, text-fig. 42) is distinguished from *Aconeceras haugi* by more pronounced costae, a high-serrated keel and a spiral depression.

Occurrence: France, Venezuela (Renz, 1982) and England (Casey, 1965).

Distribution: In Aizmusu locality, 2km east of the Urkillaga-Iberondo section, Ataun area, Lareo Formation and Urkillaga-Iberondo section, Ataun area, Lareo Formation (Fig. 6).

Subgenus *Aconeceras* (*Theganoceras*) Whitehouse, 1926
A. (*Theganoceras*) sp.

Fig. 5 D

Material: IMA-7, 9

Description: Two crushed specimens are to hand. Ribs fine, falcate, smooth around the umbilicus and more distinct near the venter, Venter with a low keel.

Discussion: Whitehouse (1926) recognised the genus *Theganoceras* as a distinct genus, but Casey (1961b) regarded it as subgenus of *Sanmartinoceras* Bonarelli as does Wright *et alii* (1996). *Theganoceras* is separated from *Sanmartinoceras* by its denser and finer ribs.

Occurrence: England, Germany, South Africa (Zululand), and Antarctica (Wright *et alii*, 1996).

Distribution: In Ataun section, Errenaga Formation (ammonite assemblage 1, Figs. 3 - 4).

Superfamily Desmoceratacea Zittel, 1895
Family Desmoceratidae Zittel, 1895
Subfamily Pseudosaynellinae Casey, 1961a
Genus *Pseudosaynella* Spath, 1923
Pseudosaynella sp.

Fig. 5 E

Material: ERG-5-4, ER-22

Description: Discoidal, involute, with flattened sides and sharpened venter. *Umbilicus* narrow with distinct rim, shell smooth or with nearly simple sigmoidal rib pattern.

Measurements:

Sample Number	D	WH	WH/D	WT
ER-22	28	15	0.53	3
Sample Number	WT/D	U	U/D	WT/WH
ER-22	0.11	4.5	0.16	0.2

Discussion: Rib pattern is the character that could be used for diagnosis. The costation is very like *Cleoniceras* PARONA & BONNARELLI, 1895. However the later genus belongs to an Albian assemblage fauna, while *Pseudosaynella* is an Aptian form. Because of compression the specimens look like *Aconeceras*, but their rib pattern is distinct. Specimens can be compared with *P.* cf. *raresulcata* (d'ORBIGNY, 1841) (CASEY, 1961a, p. 171).

Distribution: In Igaratza section, Errenaga Formation (Fig. 7).

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Ancyloceratacea GILL, 1871
Family Ancyloceratidae GILL, 1871
Subfamily Helicancylinae HYATT, 1894
Toxoceratoides ? sp.

Fig. 11 I-J

Material: SANGRE-22, 31

Description: Specimens are fragments of crushed shafts, more or less curved; shaft with spherical to sub-rectangular whorl section; ribs straight and single, one row of tubercles on each side of venter.

Discussion: Curved shaft and two rows of tubercles are characteristic for identification. Tuberculation is not clear in the specimen. The specimens are not complete, and show similarity to *Tonohamites* in its curved shaft.

Distribution: San Georgio section, Lareo Formation (Fig. 6). SZIVES & MONKS (2002) described the genus from Late Aptian-Early Albian as well.

Family Hemihoplitidae SPATH, 1924
Genus *Hemihoplites* SPATH, 1924
Hemihoplites sp.

Fig. 5 F

Material: SANGRE-27, SANGRE-34

Description: Shell evolute, sides compressed, umbilicus deep and umbilical wall vertical. Ribs straight or slightly curved, simple or branching; primary ribs mostly single, starting at the umbilical margin, secondary ribs intercalated between primaries starting in the lower part of the flank.

Discussion: The rib pattern and whorl section are the characteristics for genus and species identification. The San Georgio specimens show similarity to *H. feraudianus* (d'ORBIGNY, 1841). This species is similar to *H. varicostatus* RICCARDI & AGUIRRE-URRETA, 1989, in its growth and rib pattern, but AGUIRRE-URRETA (2002) believes the latter species is characterised by a different range of morphological variation in spite of overlap with that of *H. feraudianus*. This reasoning does not make any sense. DELANOY (1990) suggested that probably *H. feraudianus* and *H. soulueri* (COQUAND *in* MATHERON, 1878) represent morphotypes variation of a single species.

Distribution: Eskisabel section, Ataun area, Lareo Formation (Fig. 6).

Superfamily Douvilleiceratacea PARONA & BONARELLI, 1897
Family Douvilleiceratidae PARONA & BONARELLI, 1897
Subfamily Roloboceratinae CASEY, 1961b
Genus *Roloboceras* CASEY, 1954

Type species: *Ammonites hambrovi* FORBES, 1845, Early Aptian (*forbesi* Zone) SE England.

Generic characters: whorl shape semi-rounded, blunt ribs with tubercles around the umbilicus, umbilicus deep, suture line simplified with deep ventral lobe, body chamber half whorl in length, mouth border plain with a shallow umbilical sinus.

Discussion: CASEY (1961b) recognised the genus based on its whorl shape and tuberculation on the flanks.

Occurrence: Southern England, France, Spain (CASEY, 1961a; MORENO-BEDMAR *et alii*, 2009).

Roloboceras cf. *hambrovi* (FORBES, 1845)

Fig. 5 G

cf. 1845 *Ammonites Hambrovi* FORBES, p. 354, pl. xiii, fig. 4.
cf. 1906 *Ammonites Hambrovi* FROBES: SINZOW, p. 162-163.
cf. 1930 *Cheloniceras hambrovi* (FORBES): SPATH, p. 444-445.
cf. 1954 *Roloboceras hambrovi* (FORBES): CASEY, p. 114.
cf. 1961b *Roloboceras hambrovi* (FORBES): CASEY, p. 179-182, pl. 29, figs. 5-6; pl. 30, figs. 7-8; pl. 30, fig. 3a-b; pl. 32, fig. 5a-b; text-fig. 54, 55a-b, 57a-b.
cf. 2006 *Roloboceras hambrovi* (FORBES): ROPOLO *et alii*, pl. 11, fig. 2.
cf. 2008 *Roloboceras hambrovi* (FORBES): ROPOLO *et alii*, pl. 6, fig. 2.
cf. 2009 *Roloboceras hambrovi* (FORBES): MORENO-BEDMAR *et alii*, fig. 10E.
cf. 2009 *Roloboceras hambrovi* (FORBES): MORENO-BEDMAR *et alii*, fig. I, B-D, fig. II, A

Lectotype: British Geological Survey Museum, collection 2295, the larger of the two specimens figured by FORBES, from Atherfield Clay Series, Lower Lobster Bed.

Material: ERG-3-8, 3-12

Description: Two crushed specimens are to hand. Whorl section sub-rounded to sub-rectangular, venter rounded, primary ribs straight, single, thick, between each primary there are thinner ribs. Tubercles around the

umbilicus are prominent.

Discussion: The specimens show similarity to *R. horridum* (RIEDEL, 1938), but this species has more depressed adolescent whorls and tubercles that are more prominent still.

Occurrence: England (CASEY, 1954, 1961c; SPATH, 1930), France (KILIAN, 1913; ROPOLO *et alii*, 2008), Caucasus (ROUCHADZE, 1933), Russia (SINZOW, 1906), USA (HUMPHREY, 1949).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

Roloboceras cf. *saxbyi* CASEY, 1961b

Fig. 5 H

cf. 1961b *Roloboceras saxbyi* CASEY, p. 188-189, pl. 30, figs. 1a-b, 2a-b; text-fig. 57c-d.

Holotype: Natural History Museum, London, 46590, Atherfield Clay Series, Lower Lobster Bed, Atherfield, Isle of Wight.

Material: SANGRE-11, 13, 28, 30.

Description: Whorl section sub-rectangular to oval, ribs uniform, single or bifurcate from umbilical edge, lateral tubercles not very distinct.

Discussion: SPATH (1921, p. 313, quoted in CASEY, 1961b, p. 189) believed that *R. saxbyi* was comparable to *Cheloniceras gottschei* (KILIAN, 1902). Detailed examination shows they differ in ornamentation and suture line and *Cheloniceras gottschei* shows sharper ribs and a venter more flattened venter. *R. perli* also shows similarity to *R. saxbyi* but differs from the latter species in its more close and uniform ribbing and less complete tuberculation (CASEY, 1961b).

Occurrence: England (CASEY, 1961b)

Distribution: Eskisabel section, Ataun area, Lareo Formation.

Superfamily Deshayesitaceae STOYANOW, 1949

Family Deshayesitidae STOYANOW, 1949

The family is restricted to the latest Barremian to the latest Early Aptian substages. During this interval, an increase in the involution of the whorls, flatting of the venter, appearance of tubercles and a reducing curvature and weakening of the ribs at the venter can be followed in this family. Some genera with their short time ranges and distinct characters are used in Lower Cretaceous biozonation on a global scale.

Deshayesitidae is accepted as a family (WRIGHT, 1955; CASEY, 1957; MIKHAILOVA, 1958). ARKELL *et alii* (1957) considered that the family comprised three genera, *Deshayesites* KAZANSKY, 1914, *Dufrenoyia* BURCKHARDT *ex* KILIAN & REBOUL, 1915, and *Burckhardites* HUMPHREY, 1949. CASEY (1964) split the family into two subfamilies Deshayesitinae and Matheroceratinae. Subsequently new genera were proposed for the subfamily. WRIGHT *et alii* (1996) followed CASEY's subfamily suggestion at systematic level, including genera *Turkmeniceras* TOVBINA, 1962, *Prodeshayesites* CASEY, 1961b, *Deshayesites* KAZANSKY, 1914, *Neodeshayesites* CASEY, 1964, *Dufrenoyia* BURCKHARDT *ex* KILIAN & REBOUL, 1915, *Burckhardites* HUMPHREY, 1949, and *Kuntziella* COLLIGNON, 1962.

BOGDANOVA & MIKHAILOVA (1999) added a new genus *Obsoleticeras* BOGDANOVA & MIKHAILOVA, 1999, and used *Paradeshayesites* KEMPER (1967) instead of *Prodeshayesites* CASEY, 1961b, and indicated that *Neodeshayesites*, *Burckhardtites* and *Kuntziella* are possibly assigned to the family. ROBERT & BULOT (2005) have assigned *Neodeshayesites*, a genus restricted to south and central America, to the subfamily Acanthohoplitinae, but there are problems with this approach which will need addressing. Here the taxonomic classification in WRIGHT *et alii* (1996) is followed, but, the three genera *Turkmeniceras*, *Deshayesites* and *Dufrenoyia* are common in all classifications. However the suprageneric classification has been under discussion for some long time and is still unsatisfactory.

Subfamily Deshayesitinae STOYANOW, 1949

Genus *Deshayesites* KAZANSKY, 1914

Type species: *Ammonites deshayesi* LEYMERIE *in* d'ORBIGNY, 1841.

Generic characters: Discoidal, sides and venter flattened or gently convex, ventro-lateral and umbilical borders poorly defined. Involution varies from one-fifth to a little more than one-third the diameter. Sculpture of sigmoidal ribs, which tend to lose elevation at mid-flank, divisible into primaries, commencing at umbilicus, and secondaries, which are intercalated or branch from primaries on whorl side. On venter ribs are of uniform relief and are bent forwards in an arc: some species have a smooth siphonal band for a short at period young stage. Mouth-border plain, inclined forwards, sinuous, with shallow embayment at umbilicus, well-marked on test especially near aperture, where it stands out as a sheaf of hairlines. Suture line with trifid, fairly deep first lateral lobe and simplify auxiliary elements with only a gentle retraction towards umbilicus. Body chamber about half a whorl in length.

Discussion: The genus is derived directly from the latest Barremian genus *Turkmeniceras* TOVBINA, 1962. KAZANSKY (1914) introduced *Deshayesites* with *A. deshayesi* d'ORBIGNY as type species. Originally *Deshayesites* comprised species which are now distributed among *Deshayesites*, *Prodeshayesites* and *Dufrenoyia* (CASEY, 1964). Later KEMPER (1967) proposed *Paradeshayesites* KEMPER, which is similar to *Prodeshayesites.* DELANOY (1995) considered '*Prodeshayesites*' as a subjective synonym of *Deshayesites*. '*Prodeshayesites*' is limited to east Greenland, England and North Germany. In both East Greenland and eastern England it apparently precedes true *Deshayesites* (CASEY, 1961a, 1964; KELLY & WHITHAM, 1999). However, there is evidence in both Greenland and England that the earliest Aptian with *Deshayesi-*

tes oglanlensis BOGDANOVA is missing in terms of marine sediments (KELLY *et alii*, in prep.). The taxonomic status of *Prodeshayesites* is questionable; KEMPER (1995) considered it to be a synonym of *Deshayesites* and stressed the affinity of '*Prodeshayesites*' with some Turkmenian species of *Deshayesites*. BOGDANOVA & MIKHAILOVA (1999, 2004) proposed a new genus *Obsoleticeras* which is similar to *Paradeshayesites* or *Prodeshayesites*. It is suggested that *Deshayesites* be retained and all other related genera grouped in its synonymy, or possibly regarded as sub genera. The use of *Paradeshayesites* or *Prodeshayesites* is one of publication priority. *Obsoleticeras* cannot be separated from *Deshayesites*. *Parahoplitoides* SPATH (1922, p. 111) is an objective synonym of *Deshayesites* having the same type species and was proposed in ignorance of KAZANSKY's genus. Reference in Canadian literature to species of *Deshayesites* (MCLEARN, 1932; WARREN, 1937) is based on of the Albian genus *Subarcthoplites* CASEY, 1954. CASEY (1965) believed that the Colombian species described by RIEDEL (1938) as *Deshayesites stutzeri*, *D. nodosus*, *D. rotundus* and *D. colombianus* are most closely related to *Dufrenoyia* than to *Deshayesites*.

Occurrence: The genus is characteristic of the earlier Early Aptian and reported from many places Europe, Russia, Africa, Arctic, America and Iran.

Deshayesites cf. *tuarkyricus* BOGDANOVA, 1983

Fig. 5 I

nom. nud. cf. 1979 *Deshayesites tuarkyricus* BOGDANOVA, BOGDANOVA, tab. 2, fig. 2.
cf. 1983 *Deshayesites tuarkyricus sp. nov.*, BOGDANOVA, p. 132, tab. 1, figs. 1-4, tab. 2, fig. 4.
cf. 1999a *Deshayesites tuarkyricus* BOGDANOVA: CECCA *et alii*, fig. 6c-d.
cf. 1999 *Deshayesites tuarkyricus* BOGDANOVA: BOGDANOVA & PROZOROVSKY, pl. 3, fig. a-c.
cf. 1999 *Paradeshayesites tuarkyricus* (BOGDANOVA): BOGDANOVA & MIKHAILOVA, p. 527.
cf. 2000 *Deshayesites* sp. gr. *tuarkyricus* BOGDANOVA: GONNET *et alii*, pl. 1, fig. 3.
cf. 2004 *Deshayesites* cf. *tuarkyricus* BOGDANOVA: RAISOSSADAT, p. 123, fig. 4F.
cf. 2004 *Paradeshayesites tuarkyricus* (BOGDANOVA): BOGDANOVA & MIKHAILOVA, p. 212, pl. 7, fig. 7; text-figs. 19-20.

Holotype: St. Petersburg Museum, N° 1/ 9442, from Lausan, Taurkyr, Turkmenistan.

Material: IRI-1-35, 36, 44, 83, 85, 86, 102.

Description: Whorl section sub-rectangular, venter flat or broadly convex, coiling being more open in the last whorl. Ornament consists of ribs, dense and fine, primary ribs originate from the umbilical edge and are more coarser and stronger in the upper third of the whorl flanks, secondary ribs start from mid flank; every primary rib is accompanied by two secondary ribs. Thirty three primary ribs and seventy secondary ribs are present at thirty five mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
IRI-83	28.5	11	0.38		0
IRI-86	34.8	12.5	0.35		0
Holotype	90.8	46	0.5	24.3	0.26
Sample Number	**U**	**U/D**	**WT/WH**	**PR**	**SR**
IRI-83	9	0.31	0	20	
IRI-86	6	0.17	0	33	70
Holotype	17	0.18	0.52		

Discussion: Fine ribbing and the coiling pattern are the characters used for recognition. Identification is not easy because specimens show similarity to *Turkmeniceras* and *D. oglanlensis*. In fact the species could be a transition form between *Turkmeniceras* and *Deshayesites*. *D. tuarkyricus* differs from *D. oglanlensis* by its more dense rib pattern. It is supposed that *D. tuarkyricus* has been reported form Turkmenistan only and is an endemic and local species, but based on GONNET *et alii* (2000), GARCÍA-MONDEJAR *et alii* (2009) and this study, it is possible that *D. tuarkyricus* is present outside of the Kopet Dagh basin. Even if the latter specimens are not *D. tuarkyricus*, they accompany *D. oglanlensis* and are of the *D. tuarkyricus* Zone age.

Occurrence: Turkmenistan, Iran and Spain.

Distribution: Iribas section, Errenaga Formation (Fig. 8).

Deshayesites cf. *oglanlensis* BOGDANOVA, 1983

Fig. 5 J

num. nud. cf. 1979 *Deshayesites oglanlensis* BOGDANOVA: BOGDANOVA, pl. 1, fig. 5.
cf. 1983 *Deshayesites oglanlensis sp. nov.*: BOGDANOVA, p. 136, pl. 1, figs. 5-9; text-figs. 5-6.
cf. 1995 *Deshayesites oglanlensis* BOGDANOVA: DELANOY, p. 74, pl. 9, fig. 1.
cf. 1997 *Deshayesites oglanlensis* BOGDANOVA: AGUADO *et alii*, fig. 7e.
cf. 1999 *Deshayesites oglanlensis* BOGDANOVA: AVRAM, p. 441, fig. 4a-b.
cf. 1999b *Deshayesites oglanlensis* BOGDANOVA: CECCA *et alii*, pl. 1, figs. 2-4.
cf. 2000 *Deshayesites oglanlensis* BOGDANOVA: GONNET *et alii*, pl. 1, figs. 1-2; pl. 2, fig. 4.
cf. 2004 *Deshayesites oglanlensis* BOGDANOVA: RAISOSSADAT, p. 123-124, fig. 4G-H.
cf. 2004 *Paradeshayesites oglanlensis* (BOGDANOVA); BOGDANOVA & MIKHAILOVA, p. 214, pl. 7, fig. 4; text-figs. 22-23.

Holotype: St. Petersburg Museum, N° 12/ 9442. from Bolshoi Balkhan, Turkmenistan, figured by BOGDANOVA.

Material: IRI-13, 19, 54, 55, 56, 57, 65, 76, 87.

Description: Some specimens are compressed; whorl section sub-rectangular, venter rounded and narrow, flanks a little flattened, umbilicus is around one quarter of the diameter. Ribs fine and dense, palmate, fasciculate, ribs stem from well-marked peri-umbilical bulla, their relief is weaker in the middle part of the sides. Regularly every two primary ribs commence from one bullae, bifurcate or trifurcate, secondaries start from mid flank. Twenty seven primary ribs and sixty one secondary ribs are present at thirty mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
IRI-11	29	12.5	0.43		0
IRI-13	36	15	0.42		0
IRI-76		17		5	
IRI-57		19		5	
IRI-103	30	12.5	0.42		0
Holotype	37.5	17	0.46	8.4	0.22
Sample Number	U	U/D	WT/WH	PR	SR
IRI-11	3.5	0.12	0		
IRI-13	12	0.33	0		
IRI-76	10		0.29		
IRI-57			0.26		
IRI-103	7	0.23	0	27	61
Holotype	10.6	0.28	0.49	22	92

Discussion: Fine, dense ribs and peri-umbilical bullae are characteristic features of this species. DELANOY (1995) reported the density of ribs in *Deshayesites oglanlensis* as being more important in the separation of this species from *Deshayesites tuarkyricus*. AVRAM (1999) believed that the specimens described as *Deshayesites oglanlensis* by DELANOY (1995) are more closely related to *Deshayesites planicostatus* (BOGDANOVA, 1991). The Spanish material studied here looks like *Deshayesites callidiscus* CASEY, 1961c. Review of the description of *D. oglanlensis* and *D. callidiscus* from the published papers (for example CASEY, 1964; BOGDANOVA & MIKHAILOVA, 2004) show they are morphologically very similar. In my view they might be conspecific, despite the difference in age, or *D. callidiscus* is a descent of *D. oglanlensis* and they are phylogenetically related to each other. However, this view needs further study.

Occurrence: Earliest Aptian in France (DELANOY, 1995) and recorded in an assemblage ammonite fauna of *forbesi* or *weissi* Zone age. *Deshayesites oglanlensis* is a characteristic form of the *D. tuarkyricus* Zone in south Spain (AGUADO *et alii*, 1997), Romania (AVRAM, 1999), Turkmenistan (BOGDANOVA, 1979, 1983) and Iran (RAISOSSADAT, 2004).

Distribution: Iribas section, Errenaga Formation (Fig. 8).

Deshayesites cf. *antiquus* BOGDANOVA, 1983

Fig. 5 K

num. nud. cf. 1979 *Deshayesites antiquus* BOGDANOVA: BOGDANOVA, tab. 1, fig. 4.

cf. 1983 *Deshayesites antiqnuus* sp. nov. BOGDANOVA, p. 138-139, tab. 2, figs. 5-6; tab. 3, fig. 8.

cf. 1999 *Deshayesites antiquus* BOGDANOVA: BOGDANOVA & PROZOROVSKY, pl. 2, fig. e.

cf. 1999 *Deshayesites antiquus* BOGDANOVA: ROPOLO *et alii*, p. 178, pl. 16, figs. 1-3; pl. 18, fig. 1.

cf. 1999a *Deshayesites antiquus* BOGDANOVA: CECCA *et alii*, pl. 1, fig. 1.

cf. 2000 *Deshayesites antiquus* BOGDANOVA: GONNET *et alii*, p. 129, pl. 3, figs. 2-4.

cf. 2010 *Deshayesites antiquus* BOGDANOVA: MORENO-BEDMAR *et alii*, p. 292, fig. 11A.

Holotype: St. Petersburg Museum, N° 18/9442. from Bolshoi Balkhan, Turkmenistan, Lower Aptian, *Deshayesites tuarkyricus* Zone.

Material: IRI-61, 62, 90, 95, 116, 117.

Description: Whorl section sub-rectangular to oval, flanks parallel, Primary ribs nearly sharp, originating at the upper part of the umbilical wall and cross the flank in a light sigmoidal pattern, secondary ribs branch from primaries in mid flanks.

Discussion: The species appears in the *oglanlensis* Zone and can be distinguished by its density of ribs which is less than in other species which appear in this zone such as *D. tuarkyricus*, *D. oglanlensis* and *D. weissiformis*.

Occurrence: Turkmenistan, France and Spain.

Distribution: Iribas section, Errenaga Formation.

Deshayesites cf. *gracilis* CASEY, 1964

Fig. 5 L

cf. 1964 *Deshayesites* cf. *gracilis* sp. nov.: CASEY, p. 324-325, pl. 47, fig. 10.

cf. 1999 *Deshayesites gracilis* CASEY: AVRAM, p. 444, fig. 3C.

Holotype: Natural History Museum, London, C3034, Atherfield Clay Series, Crackers, Atherfield, Isle of Wight.

Material: ER-76, 79, 108, 173, 183; ERG-3-9, 3-10.

Description: Specimens are crushed and incomplete, umbilical wall vertical; Ornament consists of ribs; narrow primary ribs start from middle part of the umbilical wall, sigmoidal, secondaries intercalated between primaries, free or attached, starting from lower third of the whorl flank, some fusing with adjacent primaries.

Measurements:

Sample Number	D	WH	WH/D	WT
ER-173	30	12.5	0.41	
ERG-34-9	46.5	18.5	0.40	
Holotype	41	18.45	0.45	12.3
Sample Numbe	WT/D	U	U/D	WT/WH
ER-173	0	8	0.26	0
ERG-34-9	0	16	0.34	0
Holotype	0.3		0	0.66

Discussion: CASEY (1964) based the species on an incomplete specimen. The species differs from *D. forbesi* var. *koeneni* CASEY, 1964 by its deep umbilical wall and steep-sided ribs. *D. multicostatus* TOVBINA, 1963, shows similarity to *D. gracilis*, but the former species has stronger sigmoidal ribs and a flattened ventral area.

Occurrence: England (CASEY, 1964), Romania (AVRAM, 1999).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

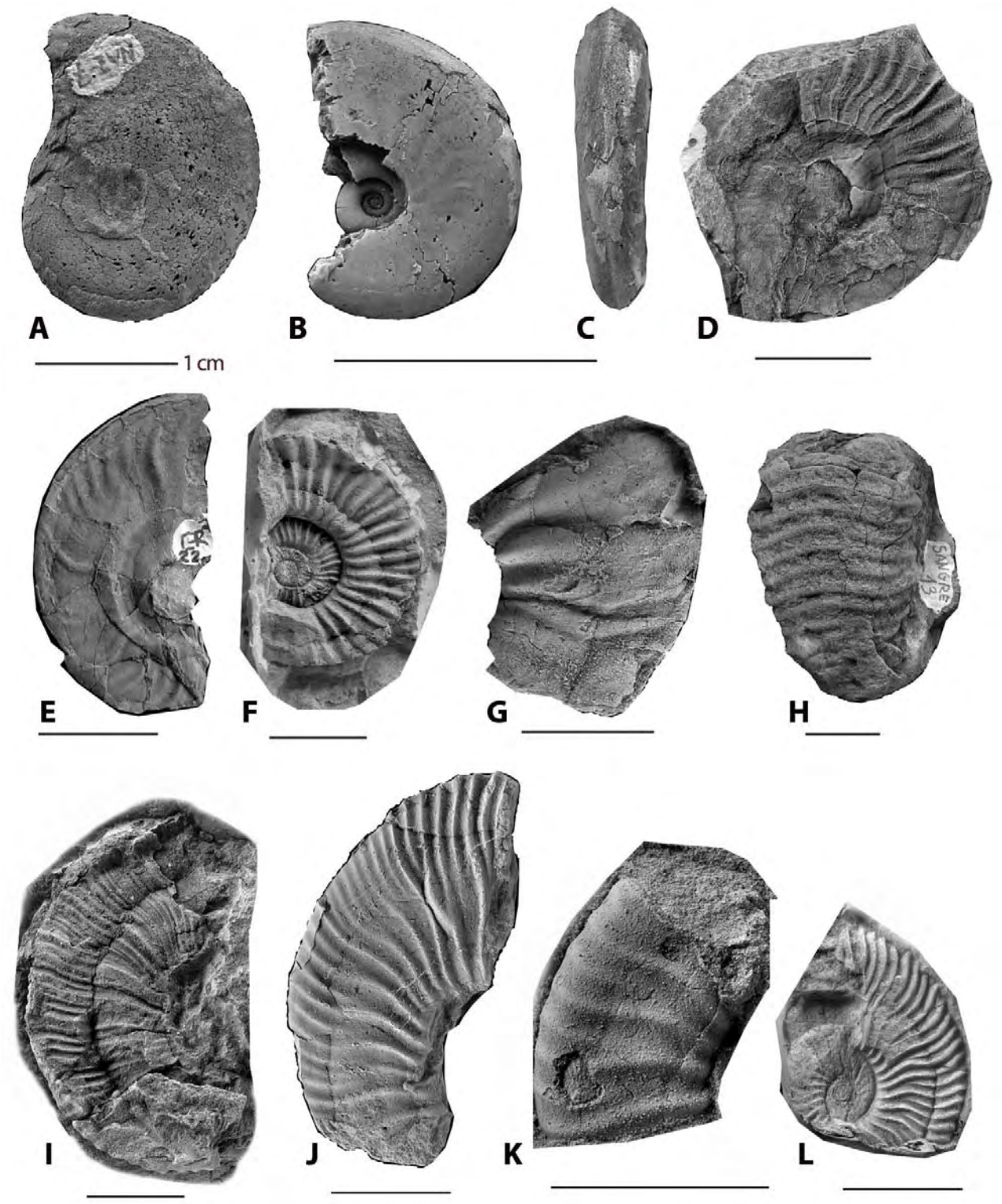


Figure 5: Early Aptian ammonites of northern Spain. A.- *Aconeceras* cf. *nisoides* (SARASIN, 1893), Lareo Formation, NAZ-7; B-C.- *Aconeceras haugi* SARASIN, 1893, Lareo Formation, AIZMUSU 2, Lareo Formation; D.- *Aconeceras* (*Theganoceras*) sp., Errenaga Formation, IMA-7; E.- *Pseudosaynella* sp., Errenaga Formation, ER-22; F.- *Hemihoplites* sp., Errenaga Formation, Sangre-34; G.- *Roloboceras* cf. *hambrovi* (FORBES, 1845), Errenaga Formation, ERG-3-8; H.- *Roloboceras* cf. *saxbyi* CASEY, 1961b, Errenaga Formation, Sangre-11; I.- *Deshayesites* cf. *tuarkyricus* BOGDANOVA, 1983, Errenaga Formation, IRI-83; J.- *Deshayesites* cf. *oglanlensis* BOGDANOVA, 1983, Errenaga Formation, IRI-57; K.- Deshayesites cf. *antiquus* BOGDANOVA, 1983, Errenaga Formation, IRI-90; L.- *Deshayesites* cf. *gracilis* CASEY, 1964, Errenaga Formation, ER-76.

Deshayesites cf. *bodei* (von KOENEN, 1902)

Fig. 9 A-B

cf. 1902 *Hoplitidae bodei* (von KOENEN), p. 221, pl. 9, fig. 1a-c.
cf. 1924 *Parahoplitoides bodei* (von KOENEN): SPATH, p. 433.
cf. 1960 *Deshayesites bodei* (von KOENEN): DRUSCHITZ & KUDRYAVTZEV, tab. 1, fig. 4.
cf. 1964 *Prodeshayesites bodei* (von KOENEN): CASEY, p. 358-359, pl. 58, figs. 4a-b, 5a-b; pl. 59, fig. 3; text-fig. 127a-b.
cf. 1967 *Deshayesites bodei* (von KOENEN): KEMPER, tab. 12-13.
cf. 1971 *Deshayesites bodei* (von KOENEN): KEMPER, pl. 30, fig. 3.
cf. 1973 *Deshayesites bodei* (von KOENEN): GLASUNOVA, pl. 91.
cf. 1979 *Prodeshayesites bodei* (von KOENEN): COLLIGNON *et alii*, p. 147, pl. 2, figs. 1a-b, 2a-b.
cf. 1995 *Deshayesites bodei* (von KOENEN): KEMPER, taf. 3, figs. 3-4; taf. 5, fig. 4.
cf. 1999 *Prodeshayesites* cf. *bodei* (von KOENEN): KELLY & WHITHAM, p. 87-88, fig. 3a-d.
cf. 2004 *Deshayesites bodei* (von KOENEN): BOGDANOVA & MIKHAILOVA, pl. 2, fig. 1.

Lectotype: The example figured by von KOENEN (1902), pl. 9, fig. 1a-c; text-fig. 127a-b, from the Lower Aptian of Timmern, Brunswick (selected by CASEY, 1964).

Material: ER-9.

Description: One crushed specimen. Whorl section sub-rectangular, flanks parallel, venter nearly curved and broad. Ribs sharp, primary ribs originate from upper part of umbilical wall and cross the flank in a sigmoidal curve; secondary ribs branch from primaries near to the umbilical margin.

Discussion: *D. bodei* is similar to *D. fissicostatus*, but differs from the latter by a wider umbilicus and coarser ribs. CASEY (1964, p. 359) indicated that at some stages of growth, the two species are very similar, but believes that since *D. bodei* is used as subzonal index it is better to keep the two as distinct. However, the presence of *D. bodei* confirms the *fissicostatus* Zone.

Occurrence: Spain (COLLIGNON *et alii*, 1979), England (SPATH, 1924; CASEY, 1964), Germany (KEMPER, 1967), Russia (DRUSCHITZ & KULRYVTZVA, 1960; GLAZUNOVA, 1973).

Distribution: Igaratza section, Errenaga Formation.

Deshayesites weissiformis BOGDANOVA, 1983

Fig. 9 C

1983 *Deshayesites weissiformis* sp. nov.: BOGDANOVA, 34, tab. 2, figs. 1-3; tab. 3, fig. 7; text-figs. 3-4.
1995 *Deshayesites weissiformis* BOGDANOVA: DELANOY, p. 74, pl. 5, fig. 2.
1999 *Deshayesites weissiformis* BOGDANOVA: AVRAM, p. 440-441, fig. 3A-E.
1999a *Deshayesites weissiformis* BOGDANOVA: CECCA *et alii*, p. 278, pl. 6, figs. 2-3.
2004 *Deshayesites* cf. *weissiformis* BOGDANOVA: RAISOSSADAT, p. 124, fig. 4.
2004 *Paradeshayesites weissiformis* (BOGDANOVA): BOGDANOVA & MIKHAILOVA, p. 212-214, pl. 7, fig. 3; text-fig. 21.

Holotype: St. Petersburg Museum, N° 7/9442, from Taurkyr, Turkmenistan.

Material: ER-2, 13, 14, 28, 55, 129?, ERG-10-1, 20-3, IRI-3, 4, 11, 15, 20, 21. 24, 32, 42, 45, 46, 59, 77, 81, 101, 102, 103, 104, 105, 109, 110, 114, 115, 107, 108, ATAN-11.

Description: Some specimens crushed and incomplete. Whorl section sub-rectangular, flanks parallel, flat and broad venter, umbilical area is between one third and one fourth of the diameter. Ornament consists of ribs; primary ribs start from the upper part of the umbilical wall with tubercles around the umbilical margin, bifurcating in the lower quarter of the flanks. Secondary ribs are of same thickness as the primaries; some intercalating between primary rib branches, starting near half way up the flank, free or attached to primaries. All ribs are curved forward on the upper part of the flank, but are straight at the ventral area. Twenty eight primary ribs and fifty eight secondary ribs are present at a diameter thirty seven mm.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
IRI-4	37	14.5	0.39	5	0.13
IRI-110	29	12.5	0.43		0
IRI-13	36.5	11	0.30		0
IRI-59	17	8	0.47		0
IRI-110	36	16	0.44		0
ATAN-26	35	14.5	0.41		0
ERG-10-1	52	19	0.36		0
Holotype	110.7	51.6	0.46	32.7	0.29

Sample Number	U	U/D	WT/WH	PR	SR
IRI-4	5	0.13	0.34	28	58
IRI-110	4.5	0.15	0		
IRI-13	9	0.24	0		
IRI-59	3.5	0.21	0	24	
IRI-110		0	0		48
ATAN-26	7	0.2	0		
ERG-10-1	16.5	0.31	0		
Holotype	26.9	0.24	0.63	24	94

Discussion: the species is identified by its fine and dense ribs. Shells are similar to *D. oglanlensis* and sometimes can not be easily separated at the same dimensions as *D. weissiformis* and *D. oglanlensis*. However the number of ribs in *D. weissiformis* is less than *D. oglanlensis* at the same diameter.

Occurrence: Turkmenistan (BOGDANOVA, 1983), France (DELANOY, 1995; CECCA *et alii*, 1999a), Romania (AVRAM, 1999) and Iran (RAISOSSADAT, 2004).

Distribution: Ataneta locality, Iribas section, Igaratza section, Iribas section, Errenaga Formation (Figs. 7 - 8).

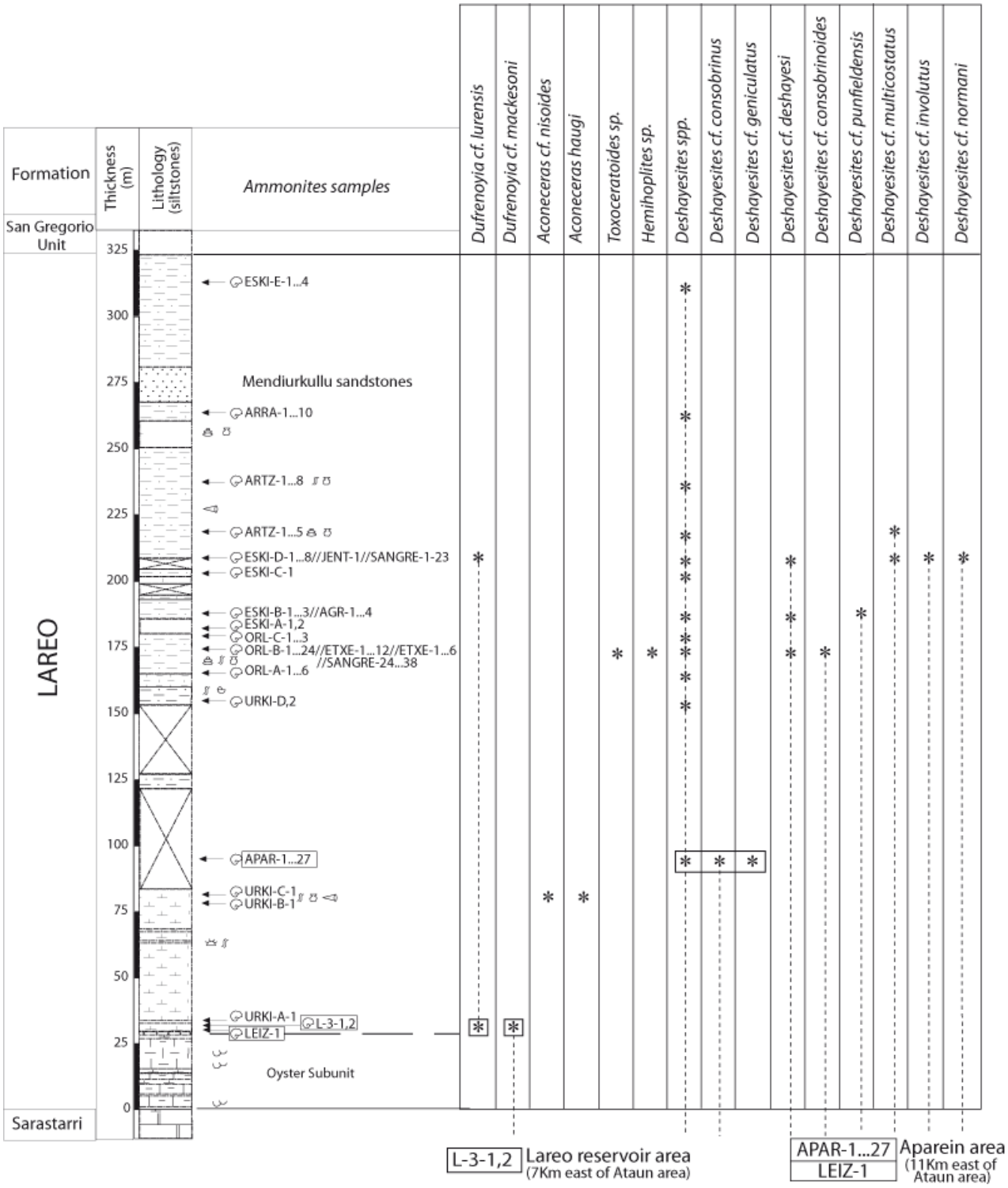


Figure 6: Ammonite range chart of the deshayesi-furcata transitional interval Zone in the composite Lareo Formation succession.

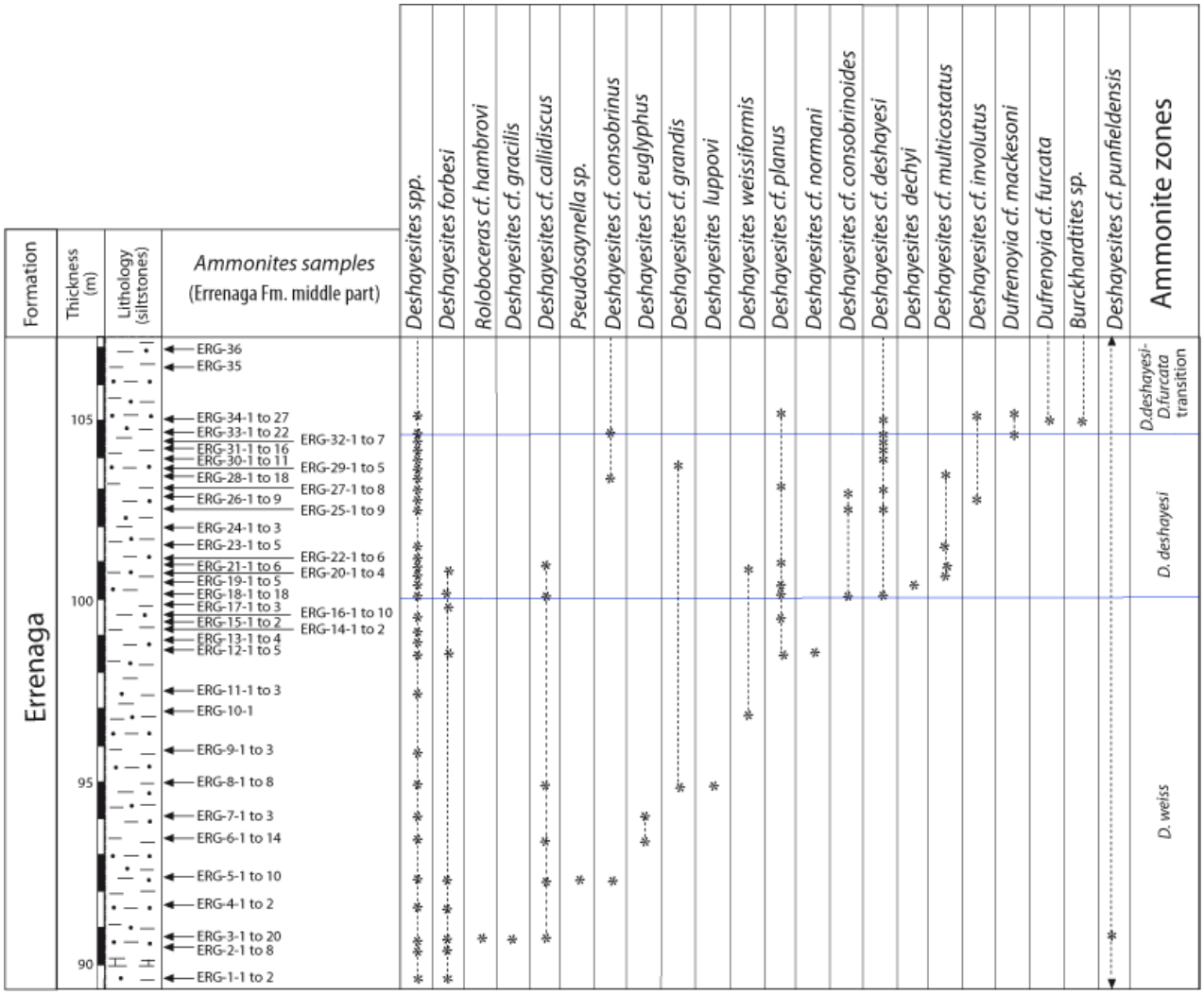


Figure 7: Ammonite range chart of the *weissi*, *deshayesi*, *deshayesi-furcata* transitional interval zones in the Errenaga Formation of the Igaratza section.

Deshayesites cf. *consobrinus* (d'Orbigny, 1841)

Fig. 9 D

cf. 1841 *Deshayesites consobrinus* (d'Orbigny), p. 147, pl. 47, figs. 1-3.
cf. 1964 *Deshayesites consobrinus* (d'Orbigny): Casey, text-figs. 123-124.
cf. 1973 *Deshayesites consobrinus* (d'Orbigny): Glanzunova, tab. 88, 89, 90.
cf. 1979 *Deshayesites consobrinus* (d'Orbigny): Bogdanova, p. 159, pl. 2, figs. 3-4.
cf. 1999 *Deshayesites consobrinus* (d'Orbigny): Bogdanova & Prozorovsky, pl. 3, figs. g-i.
cf. 1999 *Deshayesites consobrinus* (d'Orbigny): Ropolo *et alii*, pl. 19, figs. 1, 4.
cf. 2000 *Deshayesites consobrinus* (d'Orbigny): Gonnet *et alii*, pl. 5, fig. 1.
cf. 2004 *Deshayesites consobrinus* (d'Orbigny): Bogdanova & Mikhailova, p. 202-203, pl. 4, figs. 1-3.

Lectotype: Laboratoire de Paléontologie, Muséum National d'Histoire naturelle de Paris, d'Orbigny collection 5597a, Lower Aptian, La Bédoule (Bouches-du-Rhône, France) (selected Casey, 1964).

Material: ERG-5-8, 28-2, 33-15, APAR-16.

Description: Whorls sub-rectangular, flanks parallel to convex, umbilical wall nearly vertical. Ribs narrow, sharp, sigmoidal; primary ribs originate from umbilical wall, secondary ribs, attached or free, single, occurring between a pair of primaries and appear at one-third up the whorl flank: rarely more than one secondary between each pair of primaries in the last whorl.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ERG-5-8	24.5	8.5	0.34		0
Holotype	40		0	10	0.25
Sample Number	**U**	**U/D**	**WT/WH**	**PR**	**SR**
ERG-5-8	7	0.28	0	20	
Holotype	14	0.35			

Discussion: *D. consobrinus* differs from *D. deshayesi* in having less sigmoidal ribs and less overlapping whorls. Ropolo *et alii* (2000) revised collected specimens from its stratotype area that agreed with Casey's lectotype. Avram (1999, p. 452) assigned a few specimens to *D. Bogdanovae* sp. nov. Bogdanova & Mikhailova (2004, p. 209) described a new species *D.*

kemperi (BOGDANOVA & MIKHAILOVA, 2004) derived from *D. consobrinus*. The figured specimens indicate that both new species are very similar to *D. consobrinus* and might be just intraspecific variations.

Occurrence: England (CASEY, 1964), France (GONNET *et alii*, 2000), Russia (GLAZUNOVA, 1973) and Turkmenistan (BOGDANOVA & PROZOROVSKY, 1999).

Distribution: Igaratza section, Errenaga Formation (Fig. 6).

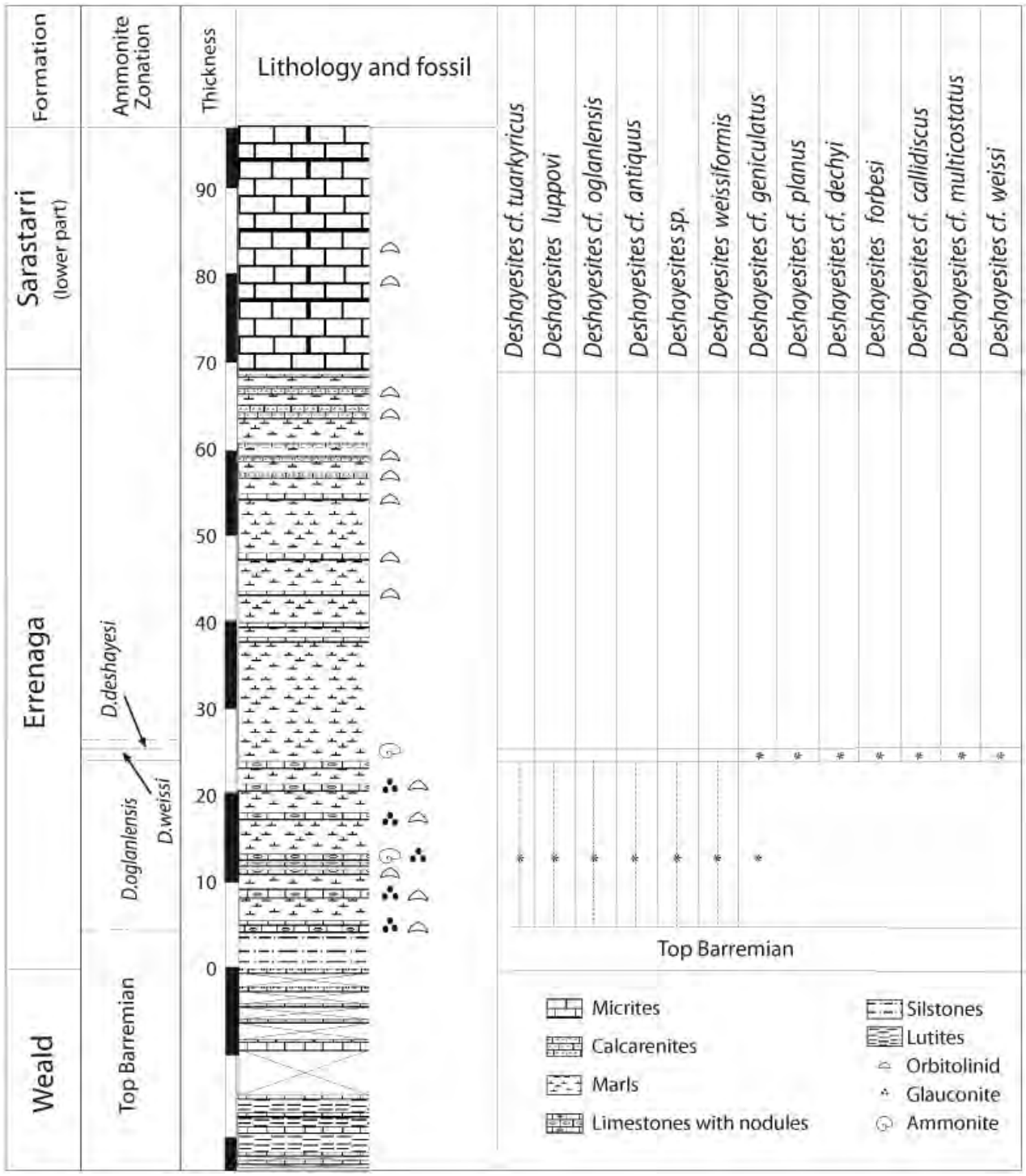


Figure 8: Ammonite range chart and biozonation for the lower part of the Errenaga Formation of the Iribas section.

Deshayesites forbesi Casey, 1961c

Fig. 9 E

1845 *Ammonites Deshayesii* Leymerie: Forbes, p. 353, pl. 13, fig. 2.
1947 *Deshayesites deshayesi* (d'Orbigny): Arkell, p. 172-173, fig. 14a-b.
1961c *Deshayesites forbesi* sp. nov.: Casey, p. 593, pl. 81, fig. 2a-b.
1964 *Deshayesites forbesi* Casey: Casey, p. 314-317, pl. 47, figs. 1-7; text-fig. 104g, 106i, 110a.
1999 *Deshayesites forbesi* Casey: Avram, p. 449, fig. 6F-H.
2009 *Deshayesites forbesi* Casey: Moreno-Bedmar *et alii*, fig. 9E.
2010 *Deshayesites forbesi* Casey: Moreno-Bedmar *et alii*, fig. 11C.

Holotype: British Geological Survey Museum, 30918, Atherfield Clay Series, Crackers, Atherfield, Isle of Wight.

Material: ER-50, 51, 65, 70, 125, 127, 135?, 137?, 138, 139, 140, 142, 143, 144, 145, 146, 147, 149, 153, 154, 156, 158, 161, 168, 169, 170, 171, 175, 177, 178, 180, 181, 185, 186, ERG-1-1, 2-1, 2-3, 2-4, 2-5, 2-7, 2-8, 3-1, 3-2, 3-5, 3-14, 3-15, 3-16, ERG-4-1, 5-1, 5-2, 5-3, 5-6, 5-9, 12-1, 17-1, 18-1, 20-2, ATAN-25, IMA 5, 6, 8, 10, 12.

Description: Whorls sub-rectangular, flanks parallel to convex, umbilical wall nearly oblique; umbilical width is between one fifth and one quarter of the diameter. Ornamentation consist of ribs; primary ribs sharp, nearly sigmoidal; secondary ribs bifurcating, appear at mid flank, rarely some primary ribs are single in later growth stages.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ER-50		11.5		8	
ER-65	31	13.5	0.43		0
ER-137	17	7	0.41	3	0.18
ER-140	19	8	0.42		0
ER-144	23	9	0.39		0
ER-145	18	8.5	0.47		0
ER-147	23	11	0.47		0
ER-156	19.5	11.5	0.58		0
ER-168	26	11.5	0.44		0
ER-171	25	11	0.44		0
ER-181	20.5	10	0.48		0
ERG-5-1	37	15	0.40		0
Holotype	72	27.3	0.38	24.4	0.33

Sample Number	U	U/D	WT/WH	PR	SR
ER-50			0.69		
ER-65	8	0.25	0		
ER-137	5	0.29	0.42	22	48
ER-140	5	0.26	0		
ER-144	5	0.22	0		
ER-145	4	0.22	0		
ER-147	5	0.22	0		
ER-156	4	0.21	0		
ER-168	4.5	0.17	0		
ER-171	5	0.2	0		
ER-181	4.5	0.22	0		
ERG-5-1	12	0.32	0		
Holotype	19.4	0.26	0.33		

Discussion: The diagnostic feature for the species is density of its ribbing. *D. forbesi* shows similarity to *D. deshayesi* in rib pattern, but the latter species has strong and more uniform ribs and also a vertical umbilical wall.

Occurrence: England (Casey, 1961c), Romania (Avram, 1999).

Distribution: Ataneta locality, Iribas section, Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *euglyphus* Casey, 1964

Fig. 9 F-G

cf. 1964 *Deshayesites euglyphus* sp. nov.; Casey, p. 336-337, pl. 52, figs. 1-4; pl. LVI, fig. 1a-b.
cf. 1979 *Deshayesites euglyphus* Casey: Collignon *et alii*, p. 148, pl. 2, fig. 4a-c.
cf. 1999 *Deshayesites euglyphus* Casey: Bogdanova, pl. 2, fig. 7.
cf. 2004 *Deshayesites* cf. *euglyphus* Casey: Raisossadat, p. 125. fig. 4I.
cf. 2010 *Deshayesites* cf. *euglyphus* Casey: Moreno-Bedmar *et alii*, fig. 11D.

Holotype: Reading University, Geology Dept., N° 6958, from Atherfield Clay Series, Atherfield, Isle of Wight, UK.

Material: ER-1, 3, 4, 5, 6, 16, 17, 40, 62, 73, 85, 103, ERG-6-8, 6-10, 6-13, 7-1.

Description: Early whorls cannot be seen because specimens are incomplete. Ornament of ribs; primary ribs start from upper part of the umbilical wall, secondary ribs attach to primaries or are free, bifurcating and originate in the lower third of the flank to mid flank, ribs more flattened and projected forward on the venter.

Measurements:

Sample Number	D	WH	WH/D	WT
ER-17		10.5		6.5
Holotype	66	29	0.44	19.8

Sample Number	WT/D	U	U/D	WT/WH
ER-17				0.61
Holotype	0.33	18.4	0.28	0.68

Discussion: The pattern of rounded and flattened ribs in the ventral area is a characteristic feature for species identification. According to Casey (1964) there are some similarities between *D. euglyphus* and *D. kiliani* Spath, 1930. The Spanish assemblage is of the *D. euglyphus* morphotype.

Occurrence: England (Casey, 1964), Spain (Collignon *et alii*, 1979) and Iran (Raisossadat, 2004).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *punfieldensis* Spath, 1930

Fig. 9 H

cf. 1930 *Deshayesites punfieldensis* Spath, p. 431-432, pl. 16, fig. 3a-b.
cf. 1964 *Deshayesites punfieldensis* Spath: Casey, p. 338-341, pl. 46, figs. 1-3.

Holotype: British Geological Survey Museum, 30915, from the Lower Lobster Bed, Atherfield, Isle of Wight (F.W. Simms University of the Basque Country).

Material: ER-77, 81, 89, 101, ERG-3-9, 3-10.

Description: Whorls sub-rectangular, sides flattened. Ornament of sharp ribs; primary ribs curved from mid-flanks, commencing from the

upper part of umbilical wall; secondary ribs start from the upper third of the flank, intercalated between primaries, mostly free or attached to the primaries.

Discussion: The rib pattern is a character for identification. There is similarity between *D. vectensis* SPATH, 1930, and *D. punfieldensis*, but the latter species has a wider umbilicus, is more coarsely ribbed and is less flattened on the venter. Hitherto, it seems, the species has not been recorded outside of England.

Occurrence: England (CASEY, 1964)

Distribution: Igaratza section, Errenaga Formation (Fig. 6).

Deshayesites luppovi BOGDANOVA, 1983

Fig. 9 I

1952 *Deshayesites* aff. *dechyi* PAPP: LUPPOV, 203, tab. 7, fig. 1.
nom. nud. 1971 *Deshayesites luppovi* sp. nov.; BOGDANOVA, 22.
1983 *Deshayesites luppovi* sp. nov.: BOGDANOVA, p. 139. tab. 3, figs. 1-6.
1997 *Deshayesites* cf. *luppovi* BOGDANOVA: AGUADO *et alii*, fig. 7f-g.
1999 *Deshayesites luppovi* BOGDANOVA: AVRAM, p. 447, fig. 5f-g.
1999 *Deshayesites luppovi* BOGDANOVA: BOGDANOVA, pl. 1, fig. 10.
1999 *Deshayesites luppovi* BOGDANOVA: BOGDANOVA & PROZOROVSKY, pl. 3, fig. f.
1999 *Deshayesites luppovi* BOGDANOVA: ROPOLO *et alii*, p. 178-179, pl. 16, figs. 4-5.
1999a *Deshayesites luppovi* BOGDANOVA: CECCA *et alii*, pl. 1, fig. 8.
2000 *Deshayesites luppovi* BOGDANOVA: GONNET *et alii*, pl. 2, figs. 1-2; pl. 4, fig. 2.
2004 *Deshayesites luppovi* BOGDANOVA: RAISOSSADAT, p. 125, figs. 5A-C, L.
2004 *Deshayesites luppovi* BOGDANOVA: BOGDANOVA & MIKHAILOVA, p. 207-208, pl. 2, figs. 8-9; text-fig. 14.
2010 *Deshayesites luppovi* BOGDANOVA: MORENO-BEDMAR *et alii*, fig. 11B.

Holotype: St. Petersburg Museum, N° 23/9442, from Bolshoi Balkhan, Turkmenistan.

Material: ER-20, 24, 43, 128, ERG-8-5, IRI-5, 7, 8, 9, 10, 16, 17,22, 23, 25, 26, 30, 43, 47, 49, 51, 52, 60, 63, 66, 67, 73, 74, 79, 80, 88, 89, 94, 96, 97, 100, 106, 112, 118.

Description: Most specimens are crushed and incomplete. Whorl section sub-rectangular, whorl height is greater than whorl width, thickest in the lower part of the whorl flank, compressed. Umbilical wall vertical, umbilical width is about one quarter of the diameter. Ornament consists of sigmoidal ribs, strongly curved backwards on the lower third of the flanks; primary ribs start from the upper part of the umbilical wall, thickest in the lower and upper part of flanks; secondaries at first are irregular and in mode of intercalation between primaries, either in ones or twos, starting from the lower third of the flank, some fusing with adjacent primaries. With further growth, ribbing becomes more regular. Twenty two primary ribs in 37 mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
IRI-49	27.5	11	0.4		0
IRI-63	37.5	16	0.42		0
IRI-67	26.5	12.5	0.47		0
IRI-100	22.5	10	0.44		0
Holotype	157	71	0.45	40	0.25

Sample Number	U	U/D	WT/WH	PR	SR
IRI-49	4.5	0.16			
IRI-63	9	0.24		23	
IRI-67	6.5	0.24		22	
IRI-100	6	0.26			
Holotype	38	0.24	0.56	34	93

Discussion: The Spanish specimens are comparable with the holotype figures in the rib pattern. S shape rib pattern is a good character for identification. Some specimens resemble *Deshayesites forbesi* and there is not much difference between *Deshayesites forbesi* and *Deshayesites luppovi* expect in their suture lines and this feature cannot be seen in the studied specimens. It seems that the rib pattern in *Deshayesites forbesi* is more regular than *Deshayesites luppovi*. *Deshayesites forbesi* differs from *Deshayesites pappi* BOGDANOVA, 1991, by the secondary ribs, which start in the upper part of the whorl flanks in the latter species.

Occurrence: Lower Aptian (*weissi* Zone) in north Caucasus and in Turkmenistan (BOGDANOVA, 1971, 1983), Romania (AVRAM, 1999) and Iran (RAISOSSADAT, 2004).

Distribution: Igaratza section, Iribas section, Errenaga Formation (Fig. 7).

Deshayesites cf. *weissi* NEUMAYR & UHLIG, 1881

Fig. 9 J

cf. 1881 *Hoplites weissi* NEUMAYR & UHLIG, p. 179, pl. 46, fig. 1; pl. 47, fig. 1.
cf. 1902 *Hoplites* (*Deshayesites*) *weissi* NEUMAYR & UHLIG: von KOENEN, p. 207, pl. 45, fig. 1.
cf. 1960 *Deshayesites weissi* (NEUMAYR & UHLIG): DRUSCHITZ & KUDRYAVTZEV, p. 310, pl. 1, fig. 1.
cf. 1971 *Deshayesites weissi* (NEUMAYR & UHLIG): BOGDANOVA, p. 22.
cf. 1977 *Deshayesites weissi* (NEUMAYR & UHLIG): BOGDANOVA, p. 47, pl. 1, figs. 1-4; pl. 4, fig. 6.
cf. 1999 *Deshayesites weissi* (NEUMAYR & UHLIG): AVRAM, p. 439, fig. 2a-c.
cf. 1999 *Deshayesites weissi* (NEUMAYR & UHLIG): BOGDANOVA & PROZOROVSKY, pl. 4, figs. b-c.
cf. 2000 *Deshayesites* sp. gr. *weissi* (NEUMAYR & UHLIG): GONNET *et alii*, pl. 6, fig. 1.
cf. 2004 *Deshayesites weissi* (NEUMAYR & UHLIG): RAISOSSADAT, p. 127, fig. 4L.

Syntypes: Both the specimens figured by NEUMAYR & UHLIG (1881) are lost; one was in the SCHLOENBACH collection in the Königlichen Geologischen Landesanstalt, Berlin, and the other was in the Geologischen Reichsanstalt, Vienna. A neotype should be designated from appropriate German material.

Material: ATAN-2, 10, 20.

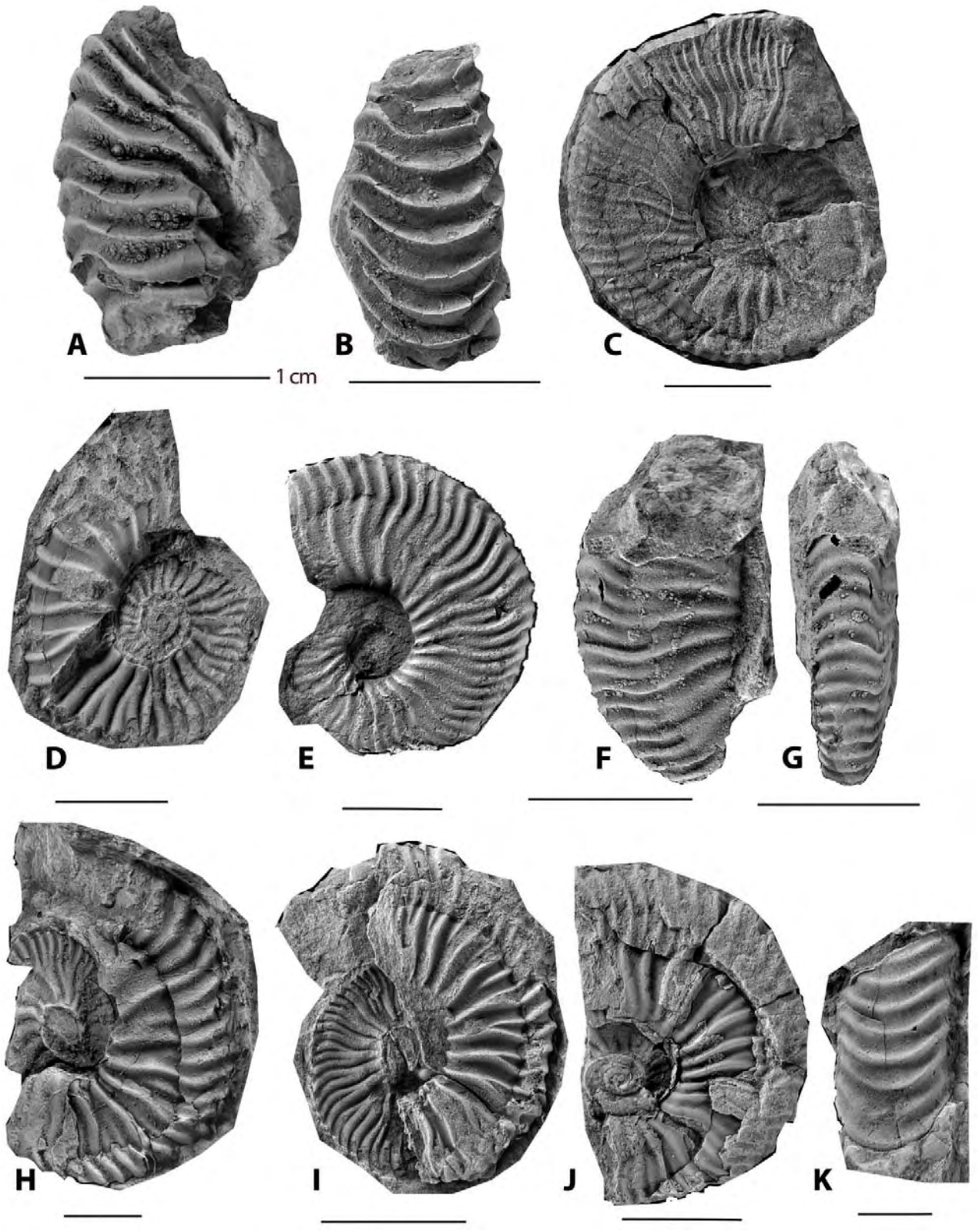


Figure 9: Early Aptian ammonites of northern Spain. A-B.- *Deshayesites* cf. *bodei* (von KOENEN) 1902, Errenaga Formation, ER-9; C.- *Deshayesites weissiformis* BOGDANOVA, 1983, Errenaga Formation, IRI-4; D.- *Deshayesites* cf. *consobrinus* (d'ORBIGNY, 1841), Errenaga Formation, ERG-5-8; E.- *Deshayesites forbesi* CASEY, 1961c, Errenaga Formation, ER-137; F-G.- *Deshayesites* cf. *euglyphus* CASEY, 1964, Errenaga Formation, ER-17; H.- *Deshayesites* cf. *punfieldensis* SPATH, 1930, Errenaga Formation, ERG-3-9; I.- *Deshayesites luppovi* BOGDANOVA, 1983, Errenaga Formation, IRI-94; J.- *Deshayesites* cf. *weissi* NEUMAYR & UHLIG, 1881, Errenaga Formation, ATAN-20; K.- *Deshayesites* spp., Errenaga Formation, IRI-53.

Description: Whorl height greater than whorl thickness, subparallel flanks. Ribs start from umbilical wall, S shaped, bifurcating in the lower third to mid flank; some secondary ribs are free and unattached to the primary ribs, projected forward in ventral area; secondary ribs are about twice in number to the primaries. In small specimens, ribs are stronger and more dense.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ATAN-20	29	13.5	0.46		0
Holotype	157	71	0.45	40	0.25
Sample Number	U	U/D	WT/WH	PR	SR
ATAN-20	7	0.24	0		
Holotype	38	0.24	0.56	34	93

Discussion: Curved compact (dense) ribs are characteristic for specific separation. However their density is less than that of *D. tuarkyricus* and *D. weissiformis*. The rib pattern *of D. weissi* is similar in some cases to *D. tuarkyricus* at small diameter, but at larger diameter the ribs are coarser in *D. weissi* and differ from *D. tuarkyricus*. BOGDANOVA & MIKHAILOVA (2004) believe *D. weissi* is a transition form between *D. tuarkyricus* and *D. weissiformis*.

Occurrence: Germany (von KOENEN, 1902), Russia (DRUSCHITZ & KUDRYTZEVA, 1960), Turkmenistan (BOGDANOVA, 1977), Romania (AVRAM, 1999).

Distribution: Ataneta locality, Iribas section, Errenaga Formation (ammonite assemblage 11, Figs. 3 - 4).

Deshayesites dechyi PAPP, 1907

Fig. 10 A

1907 *Parahoplites dechyi*; PAPP, p. 171, pl. 9, figs. 1-5.
1952 *Deshayesites dechyi* PAPP: LUPPOV, p. 204, pl. 7, figs. 2-4.
1960 *Deshayesites dechyi* PAPP: DRUSCHITZ & KUDRYAVTZEV, p. 310, pl. 1, fig. 6.
1977 *Deshayesites dechyi* PAPP: BOGDANOVA, p. 50, pl. 2, figs. 1-5.
1979 *Deshayesites dechyi* PAPP: BOGDANOVA *et alii*, p. 5, pl. 1, figs. 1-5; pl. 2, figs. 1-3; text-fig. 2.
1999 *Deshayesites dechyi* PAPP: BOGDANOVA, pl. 2, figs. 3-4.
1999 *Deshayesites dechyi* PAPP: BOGDANOVA & PROZOROVSKY, pl. 4, fig. h.
2004 *Deshayesites dechyi* PAPP: RAISOSSADAT, p. 129, fig. 4M-N.
2004 *Deshayesites dechyi* PAPP: BOGDANOVA & MIKHAILOVA, p. 203-204, pl. 3, figs. 6-8.

Lectotype: K7593 Geological Museum of the Geological Institute of Hungary, Budapest (selected by BOGDANOVA from PAPP collection pl. 9, fig. 3), Lower Aptian, Lavaschi, Daghestan.

Material: ER-36?, 58, 59, 63, 64, 83, 88, 91, 92, 113, ERG-19-4, 20-1, ATAN-15.

Description: Whorl section sub-rectangular, semi-involute; umbilical area is about one quarter of the diameter. Ribs sigmoidal, maximum elevation and strength at lower third of sides, one or two secondary ribs are intercalated with primaries; in last half whorl ribs are more regular. Twenty two primary ribs and forty four secondary ribs are present 21 mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ER-58	33	12.5	0.38		0
ER-113	26	13.5	0.51		0
ATAN-15	21	10	0.47	3.5	0.16
Holotype	122	48.5	0.4	30.5	0.25
Sample Number	U	U/D	WT/WH	PR	SR
ER-58	8	0.24			
ER-113	7	0.26			
ATAN-15		0		22	44
Holotype	34	0.27	0.62		

Discussion: Rib pattern and suture line are characteristic for species identification. *Deshayesites dechyi* is similar to *D. forbesi* in rib pattern, but the latter is more evolute and has less strong ribs. *D. dechyi* differs from *D. consobrinoides* SINZOW, 1909, by a less convex venter and from *Deshayesites consobrinus* by having irregularly branching ribs (BOGDANOVA *et alii*, 1979). In whorl section *D. dechyi* is similar to *Prodeshayesites bodei*. The main difference between these two species lies in the suture line. The suture of *D. dechyi* is characterised by narrow and high elements. Moreover the rib pattern *of D. dechyi* is denser than *D. bodei*.

Occurrence: Early Aptian northwest and north Caucasus (*dechyi-deshayesi* Zone) (DRUSCHITZ & KUDRYAVTZEV, 1960; BOGDANOVA *et alii*, 1979), Caspian region (*weissi-deshayesi* Zone) (BOGDANOVA, 1977) and Kopet Dagh (RAISOSSADAT, 2004).

Distribution: Ataneta locality, Iribas section, Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *callidiscus* CASEY, 1961c

Fig. 10 B

cf. 1961c *Deshayesites callidiscus* sp. nov.: CASEY, p. 594, 507, 609, pl. 80, fig. 10.
cf. 1964 *Deshayesites callidiscus* CASEY, p. 327-328, pl. 49, figs. 3a-b, 4a-b; pl. 51, fig. 3; pl. 53, fig. 2a-b; text-fig. 114a.
cf. 1971 *Deshayesites callidiscus* CASEY: KEMPER, pl. 22, fig. 4.
cf. 1979 *Deshayesites callidiscus* CASEY: COLLIGNON *et alii*, p. 149, pl. 3, fig. 4a-b.
cf. 1999 *Deshayesites callidiscus* CASEY: BOGDANOVA & PROZOROVSKY, pl. 6, figs. e-f.
cf. 2000 *Deshayesites callidiscus* CASEY: GONNET *et alii*, pl. 6, fig. 3.
cf. 2002 *Deshayesites callidiscus* CASEY: BARABOSHKIN & MIKHAILOVA, pl. 1, fig. 1.
cf. 2004 *Paradeshayesites callidiscus* (CASEY): BOGDANOVA & MIKHAILOVA, p. 211-212, pl. 3, fig. 1; pl. 8, figs. 1-2; pl. 10, fig. 1; text-fig. 18.

Holotype: Natural History Museum, London, 48836, Atherfield Clay Series, Crackers, Atherfield, Isle of Wight.

Material: ER-11, 21, 25, 27, 29, 32, 34, 37, 42, 44, 47, 52, 53, 61, 62, 93, 100, 126, 133, ERG-3-13, 6-7, 8-1, 8-2, 18-7, 18-16, 21-3, 21-4, ATAN-7, 8, 16, 19, 31.

Description: Whorl section sub-rectangular, flanks parallel to convex, umbilical wall nearly

vertical, umbilical width is between one fifth and one quarter of the diameter. Ribs low, flat topped in the upper part and around the venter, primary ribs originate from just above the umbilical wall, secondary ribs, mostly single, originate at the mid flank, rarely more than one secondary rib between each pair of primaries in the last whorl. Twenty six primary ribs at umbilical margin and forty eight primary and secondary ribs in ventral margin at 28 mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ER-21	88	41	0.46	16	0.18
ER-47	27	12	0.44		0
ER-93	37.5	18	0.48		0
ERG-8-1	29.5	12	0.40		0
ERG-21-3	25	10	0.4		0
ERG-21-4	27.8	11	0.39		0
Holotype	110	53.9	0.48	29.7	0.27
Sample Number	U	U/D	WT/WH	PR	SR
ER-21	24.5	0.27	0.39		
ER-47		0	0		
ER-93	7.5	0.2	0		
ERG-8-1	5.5	0.19	0		
ERG-21-3	6	0.24	0	18	
ERG-21-4	5	0.18	0	26	48
Holotype	25.3	0.23	0.55		

Discussion: Flattened ribs in the upper part of the flank is a character for the species. *D. callidiscus* differs from *D. kiliani* SPATH, 1930, in its stronger, denser and more sigmoidal ribs. The whorl section is also more rectangular. *D. callidiscus* shows affinity with *D. grandis* (SPATH, 1930), but the latter species has denser ribs and degeneration of ribbing does not extend to umbilical margin. *D. callidiscus* shows similarity to *D. topleyi* (SPATH, 1930), but the former species has less sharp ribs.

Occurrence: Spain (COLLIGNON *et alii*, 1979), England (CASEY, 1964), France (GONNET *et alii*, 2000), Russia (BARABOSHKIN & MIKHAILOVA, 2002) and Turkmenistan (BOGDANOVA & PROZOROVSKY, 1999).

Distribution: Ataneta locality, Iribas section, Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *normani* CASEY, 1964

Fig. 10 C

cf. 1930 *Deshayesites* sp. nov.: SPATH, p. 431, pl. 17, fig. 5.
cf. 1961c *Deshayesites* sp. nov.: CASEY, p. 507, 609.
cf. 1964 *Deshayesites normani* sp. nov.: CASEY, p. 344-347, pl. 50, fig. 7; pl. 54, fig. 1; pl. 55, figs. 2-4; pl. 56, fig. 3; pl. 57, figs. 7-8; text-fig. 121.
cf. 1999 *Deshayesites normani* CASEY: AVRAM, p. 450-451, fig. 7C-D.
cf. 2000 *Deshayesites* sp. gr. *spathi* / *normani* CASEY: GONNET *et alii*, pl. 5, fig. 2.

Holotype: SEDGWICK Museum, Cambridge, SM B27036, Atherfield Clay series, Crackers, Atherfield, Isle of Wight.

Material: ERG-12-4, SANGRE-23.

Description: Whorl section sub-rectangular, whorl height is nearly equal to whorl width, umbilical wall vertical; sides flattened, venter nearly convex. Ornament consists of ribs, primary ribs thick, sigmoidal, projected backwards on the mid flanks, starting from umbilical wall, secondaries bifurcate from mid flank. On the venter side ribs are nearly straight.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-12-4	30	13.5	0.45	
ERG-30-1	28.5	12.5	0.43	
Holotype	173	62.2	0.36	
Sample Number	WT/D	U	U/D	WT/WH
ERG-12-4	0	8	0.26	0
ERG-30-1	0	5.5	0.19	0
Holotype	0		0	0

Discussion: *D. normani* shows similarity in rib pattern to *D. spathi* CASEY, 1961c, but differs in its more rectangular venter, fewer secondary ribs and absence of smoothness in middle of the sides.

Occurrence: England (CASEY, 1964), Romania (AVRAM, 1999).

Distribution: Igaratza section, Errenaga Formation, Eskisabel section, Ataun area, Lareo Formation (Fig. 7).

Deshayesites cf. *saxbyi* CASEY, 1964

Fig. 10 D

cf. 1930 *Deshayesites consobrinoides* (SINZOW): SPATH, p. 427.
cf. 1961c *Deshayesites* sp. nov.: CASEY, p. 507, 609.
cf. 1964 *Deshayesites saxbyi* sp. nov.: CASEY, p. 349-350, pl. 53 fig. 1a-c; pl. 56, fig. 6a-b.

Holotype: Natural History Museum, London, 46587, Atherfield Clay Series, Crackers, Atherfield, Isle of Wight (SAXBY collection).

Material: ER-46, 54, 74, 118, 172, ERG-18-2, 25-3, 26-3, 28-2, SANGRE-13, 28, 30.

Description: Umbilical wall nearly vertical, sides parallel. Ribs strong, primary ribs sigmoidal, originating from just above the umbilical wall, secondary ribs in one or twos, mostly attached but some free originating at the lower or mid flank.

Discussion: *D. saxbyi* differs from *D. latilobatus* (SINZOW, 1909), in its less flattened sides and ribbing which is sharper than *D. latilobatus*. *D. saxbyi* might show similarity with *D. consobrinoides* SINZOW, 1909, but the latter species has more regular ribbing which rarely bifurcates.

Occurrence: England (CASEY, 1964).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *involutus* SPATH, 1930

Fig. 10 E

cf. 1930 *Deshayesites involutus* SPATH, p. 432.
cf. 1961c *Deshayesites involutus* SPATH: CASEY, p. 609.
cf. 1964 *Deshayesites involutus* SPATH: CASEY, p. 310, pl. 45, figs. 1a-c, 4a-b; text-fig. 107.
cf. 1999 *Deshayesites* cf. *involutus* SPATH: AVRAM, p. 454, fig. 8d.
cf. 2004 *Deshayesites* cf. *involutus* SPATH: RAISOSSADAT, p. 129-130, fig. 6A-C.

Holotype: British Geological Survey, N°

30919, from Hythe beds, Hythe, Kent, UK.

Material: ERG-26-2, 26-8, 34-13, 34-8, SANGRE-2.

Description: Umbilical wall vertical with rounded shoulders, umbilical area is around one third of diameter. Ribs weakly sigmoidal in shape, primaries smooth at mid-flank and strong near the umbilical margin and at the ventral area, costate near the umbilical wall. Bifurcate or trifurcate, secondary ribs irregular, start in the mid flank.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ERG-34-8	41	15.5	0.37		0
Holotype	122	48.5	0.4	30.5	0.25
Sample Number	U	U/D	WT/WH	PR	SR
ERG-34-8	11.5	0.28	0	24	
Holotype	34	0.28			

Discussion: Rib pattern is comparable to figured specimens of *Deshayesites involutus* and differs from *Deshayesites grandis* in finer ribbing. The incomplete specimens are insufficient to permit precise identification.

Occurrence: England (SPATH, 1930; CASEY, 1964), Romania (AVRAM, 1999) and Iran (RAISOSSADAT, 2004).

Distribution: Igaratza section, Errenaga Formation (Figs. 6 - 7).

Deshayesites cf. *planus* CASEY, 1961c

Fig. 10 F

cf. 1961c *Deshayesites planus* CASEY, p. 609.
cf. 1964 *Deshayesites planus* CASEY: CASEY, p. 323, pl. 57, fig. 5; text-figs. 112a-b, e.
cf. 1971 *Deshayesites planus* CASEY: BOGDANOVA, p. 22.
cf. 1977 *Deshayesites planus* CASEY: BOGDANOVA, p. 52, pl. 3, figs. 1-5; pl. 4, figs. 7-8; text-fig. 4a-b.
cf. 1999 *Deshayesites planus* CASEY: AVRAM, p. 445, fig. 5c-e.
cf. 1999 *Deshayesites planus* CASEY: BOGDANOVA & PROZOROVSKY, pl. 4, figs. g, i.
cf. 2004 *Deshayesites* cf. *planus* CASEY: RAISOSSADAT, p. 130, fig. 5J-K.

Holotype: British Geological Survey, ZM 1667 (CASEY collection), from Atherfield Clay Series, Atherfield, Isle of Wight, UK.

Material: ER-8, 12, 31, 41, 48, 60, 84, 94, ERG-12-2, 16-1, 18-5, 19-1, 22-3, 22-4, 22-5, 28-7, 34-1, 34-3, 34-4, 34-6, ATAN-24, 26, 28.

Description: Whorl section sub-rectangular, thickest in the lower one third of flanks; umbilical area is one third of diameter. Ribs narrow; primary ribs originate from upper part of umbilical wall and cross the flank in a sigmoidal curve, maximum elevation at lower third of flank, minimum elevation in middle of flank. Tubercles are apparent around the umbilical margin as a result of thickening of the ribs. One or two secondary ribs are intercalated between each pair of primaries.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ER-94	17	7.5	0.44		0
ERG-28-7	26	11	0.42		0
Holotype	33	14.7	0.46	11	0.33
Sample Number	U	U/D	WT/WH	PR	SR
ER-94	4.5	0.26		18	
ERG-28-7	6	0.23			
Holotype	7.9	0.24	0.74		44

Discussion: Ribs are strong at the umbilical margin with low elevation at mid-flank and with evolute coiling are features characteristic of this species. Measured dimensions similar to the holotype.

Occurrence: England (CASEY, 1964), Romania (AVRAM, 1999), Turkmenistan (BOGDANOVA, 1977) and Iran (RAISOSSADAT, 2004).

Distribution: Ataneta locality, Iribas section Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *multicostatus* SWINNERTON, 1935

Fig. 10 G

cf. 1935 *Deshayesites multicostatus* SWINNERTON, p. 31, pl. 1, fig. 1a-c.
cf. 1961c *Deshayesites multicostatus* SWINNERTON: CASEY, p. 508, 523, 569, 570, 609.
cf. 1964 *Deshayesites multicostatus* SWINNERTON: CASEY, p. 304-305, pl. 43, figs. 5a-b, 6.
cf. 1973 *Deshayesites multicostatus* SWINNERTON: GLAZUNOVA, p. 130, pl. 84, fig. 1.
cf. 1999 *Deshayesites multicostatus* SWINNERTON: AVRAM, p. 441, fig. 3b-d.
cf. 2004 *Deshayesites* cf. *multicostatus* SWINNERTON: RAISOSSADAT, p. 132, fig. 5M.

Holotype: Natural History Museum, London, C36366 (SWINNERTON collection), from the Sutterby, Marl of Sutterby Lincolnshire, UK.

Material: ER-45, ERG-23-1, 23-2, 28-5, ATAN-3, 4, SANGRE-1, 2, 18.

Description: Whorls sub-rectangular, sides flattened, venter convex. Ornament consisting of slightly rounded ribs; primary ribs commence from umbilical wall, are sigmoidal, at first and straighter in the last whorl of adult specimens. Secondary ribs single or in pairs, interposed between primaries mostly free in early whorls and attach in last half whorl.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-23-1	31.5	13.5	0.42	4
Holotype	50	24	0.48	
Sample Number	WT/D	U	U/D	WT/WH
ERG-23-1	0.12		0	0.29
Holotype	0	13	0.26	0

Discussion: Dense ribs in ventral area and small umbilicus are characteristic of *D. multicostatus.* It is distinguished from *D. deshayesi* var. *strigosus* CASEY by its sharper and denser ribbing and more stronger curved ribs. The Spanish specimens are comparable to CASEY's figures.

Occurrence: England (CASEY, 1961c, 1964),

Russia (GLAZUNOVA, 1973), Romania (AVRAM, 1999) and Iran (RAISOSSADAT, 2004).

Distribution: Ataneta locality, Iribas section, Igaratza section, Errenaga Formation, Eskisabel section, Ataun area, Lareo Formation (Figs. 6 - 7).

Deshayesites cf. *deshayesi* LEYMERIE *in* d'ORBIGNY, 1841

Fig. 10 H

- cf. 1841 *Ammonites deshayesi* LEYMERIE *in* d'ORBIGNY, p. 288, pl. 85, figs. 3-4.
- cf. 1899 *Hoplites deshayesi* LEYMERIE: ANTHULA, p. 108.
- cf. 1914 *Hoplites* (*Deshayesites*) *deshayesi* KAZANSKY, p. 100-103, pl. 6, figs. 81-83; pl. 7, figs. 100-101.
- cf. 1960 *Deshayesites deshayesi* (d'ORBIGNY): DRUSCHITZ & KUDRYAVTZEV, p. 309, pl. 1, figs. 2, 5.
- cf. 1961c *Deshayesites deshayesi* (d'ORBIGNY): CASEY, p. 508, 523, 538, 593, 609.
- cf. 1964 *Deshayesites deshayesi* (d'ORBIGNY): CASEY, p. 295, pl. 43, fig. 3; pl. 47, fig. 9; pl. 51, fig. 6 (see for extensive synonymy).
- cf. 1971 *Deshayesites deshayesi* (d'ORBIGNY): BOGDANOVA, pl. 3, fig. 6; pl. 4, figs. 1-2.
- cf. 1971 *Deshayesites deshayesi* (d'ORBIGNY): KEMPER, pl. 29, fig. 7.
- cf. 1973 *Deshayesites deshayesi* (d'ORBIGNY): GLAZUNOVA, p. 120, pl. 76, fig. 1.
- cf. 1977 *Deshayesites deshayesi* (d'ORBIGNY): BOGDANOVA, p. 55, pl. 3, fig. 6; pl. 4, figs. 1-2.
- cf. 1979 *Deshayesites deshayesi* (d'ORBIGNY): BOGDANOVA, pl. 2, fig. 6.
- cf. 2004 *Deshayesites deshayesi* (d'ORBIGNY): RAISOSSADAT, p. 130-131, fig. 5D-E & 5H-I.
- cf. 2004 *Deshayesites deshayesi* (d'ORBIGNY): AMEDRO & MARTIN, p. 80, pl. 1, figs. 11, 13.
- cf. 2010 *Deshayesites deshayesi* (d'ORBIGNY): MORENO-BEDMAR, *et alii*, fig. 11, E-G, I; fig. IV, I-L.

Lectotype: Muséum National d'Histoire Naturelle de Paris, N° 5579c. Selected by CASEY (1961c) from d'ORBIGNY's surviving syntypes. Argiles à Plicatules of Bailly-aux-Forges, Paris Basin, France.

Material: ERG-18-19, 25-5, 25-7, 27-1, 27-2, 28-4, 28-6, 30-1, 30-9, 30-11, 31-1, 31-4, 31-5, 33-1, 31-7, 31-9, 31-12, 32-1, 32-2, 33-5, 34-10, SANGRE-2, 3, 14, ORL-B-1, 2, 21.

Description: Umbilical wall nearly vertical, umbilical width is between one third and one quarter of the diameter. Whorls sub-rectangular, flanks parallel to convex, venter subtruncate. Ribs narrow, sigmoidal; primary ribs originate from just above the umbilical wall, secondary ribs commence forward of the primaries at the mid flank, rarely more than one secondary between each pair of primaries in the last whorl. Twenty four primary ribs at umbilical margin and fifty primary and secondary ribs in ventral margin at 33 mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT	WT/D
ERG-33-1	44.5	20	0.45		0
ERG-31-7	20	9	0.45		0
ERG-31-12	17.5	8	0.45		0
ERG-33-1	33	16	0.48		0
SANGRE-3	52	21	0.40		0
Lectotype	32	14.72	0.46	9.28	0.29
Sample Number	**U**	**U/D**	**WT/WH**	**PR**	**SR**
ERG-33-1	12	0.26	0		
ERG-31-7	6	0.3			
ERG-31-12	8	0.45	0	20	41
ERG-33-1		0	0	24	50
SANGRE-3	11	0.21	0	24	48
Lectotype	10.56	0.33	0.63		

Discussion: Because of the similarity in ontogeny in the early stage of growth in *Deshayesites* and *Dufrenoyia*, small specimens might show similarity in their flattened venter and effacing ribs in the ventral area. However the presence of *Deshayesites* in these beds suggests a correct assignation to *Deshayesites* for these samples. Some specimens are weathered and rib numbers cannot be counted. The Aralar material is comparable to specimens of *D. deshayes*i in the Natural History Museum, London, numbers C4041, C71943-5, C71447-52.

Occurrence: England (CASEY, 1964); Russia (DRUSCHITZ & KUDRYAVTZEV, 1960; GLAZUNOVA, 1973); Turkmenistan (BOGDANOVA, 1977, 1991) and Iran (RAISOSSADAT, 2004).

Distribution: Igaratza section, Errenaga Formation, Eskisabel section, Ataun area, Lareo Formation (Figs. 6 - 7).

Deshayesites cf. *consobrinoides* SINZOW, 1909

Fig. 10 I

- cf. 1909 *Parahoplites consobrinoides* SINZOW, p. 3-4.
- cf. 1947 *Deshayesites consobrinoides* d'ORBIGNY: ARKELL, p. 170, figs. 18, 14b.
- cf. 1961c *Deshayesites consobrinoides* d'ORBIGNY: CASEY, p. 508, 523, 609.
- cf. 1964 *Deshayesites consobrinoides* SINZOW: CASEY, p. 302, pl. 44, figs. 5-6; pl. 52, fig. 2; text-fig. 106j-n (see for extensive synonyms).
- cf. 1971 *Deshayesites consobrinoides* SINZOW: BOGDANOVA, pl. 3, fig. 3.
- cf. 1973 *Deshayesites consobrinoides* SINZOW: GLAZUNOVA, p. 123, pl. 77, figs. 1-5.
- cf. 1979 *Deshayesites consobrinoides* SINZOW: BOGDANOVA *et alii*, pl. 3, fig. 3.
- cf. 1999 *Deshayesites consobrinoides* SINZOW: BOGDANOVA, pl. 2, fig. 1.
- cf. 1999 *Deshayesites consobrinoides* SINZOW: BOGDANOVA & PROZOROVSKY, pl. 6, figs. c-d.
- cf. 2000 *Deshayesites consobrinoides* SINZOW: GONNET *et alii*, pl. 3, fig. 1.
- cf. 2004 *Deshayesites consobrinoides* SINZOW: BOGDANOVA & MIKHAILOVA, pl. 1, figs. 4-6.
- cf. 2004 *Deshayesites* cf. *consobrinoides* SINZOW: RAISOSSADAT, p. 131-132, figs. 4O, P, 5F, G.

Lectotype: KARPINSKY Museum, St. Petersburg (one of the specimens collected by SINZOW, 1898), N° 17727, from the Lower Aptian of Saratov, Russia.

Material: ERG-18-17, 25-3, 26-1, ORL-B-7, 12, 15.

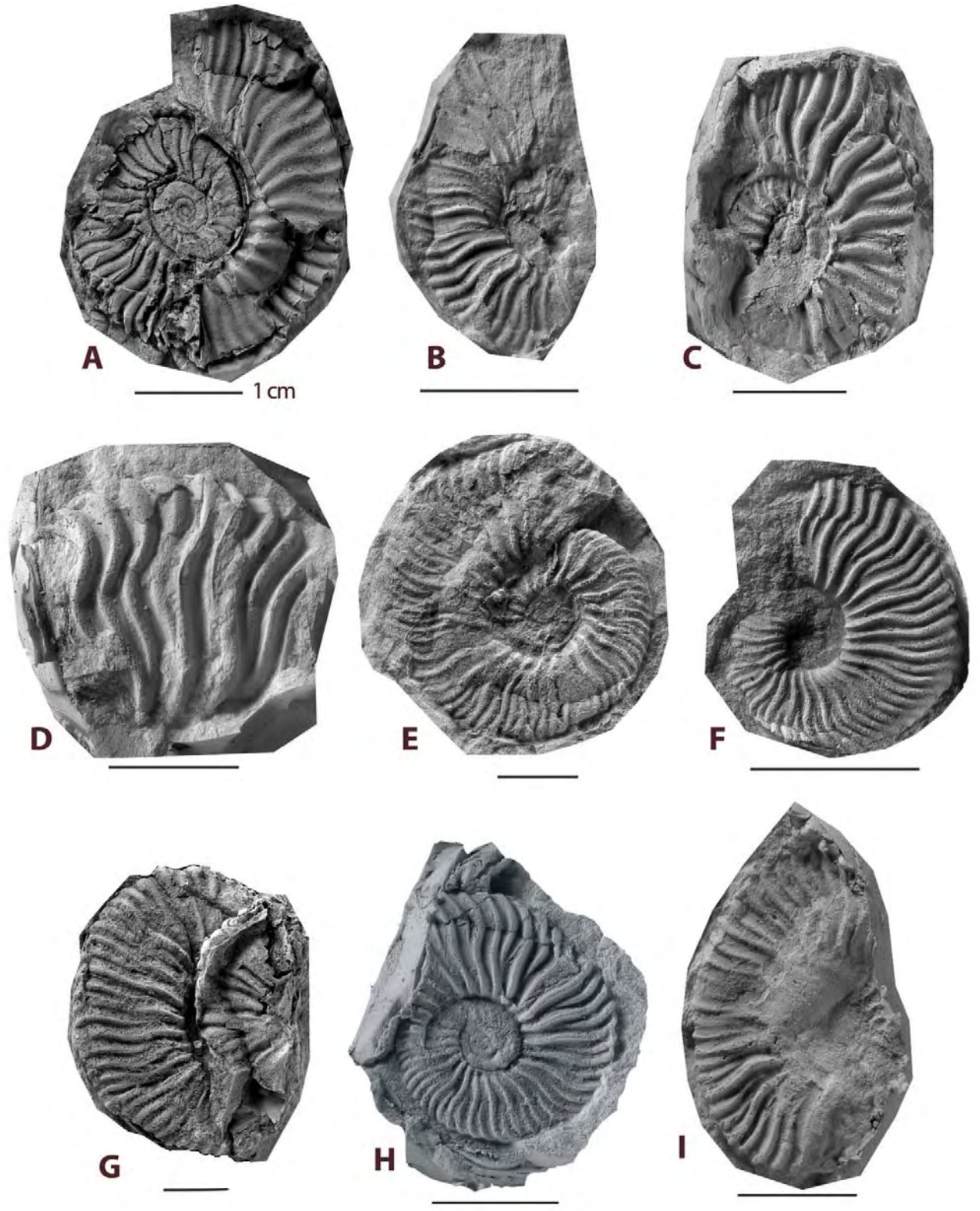


Figure 10: A.- *Deshayesites dechyi* PAPP, 1907, Errenaga Formation, ER-58; B.- *Deshayesites* cf. *callidiscus* CASEY, 1961c, Errenaga Formation, ATAN-16; C.- *Deshayesites* cf. *normani* CASEY, 1964, Errenaga Formation, ERG, 12-4; D.- *Deshayesites* cf. *saxbyi* CASEY, 1964, Errenaga Formation, ER-118; E.- *Deshayesites* cf. *involutus* SPATH, 1930, Errenaga Formation, ERG-34-8; F.- *Deshayesites* cf. *planus* CASEY, 1961c, Errenaga Formation, ER-94; G.- *Deshayesites* cf. *multicostatus* SWINNERTON, 1935, Lareo Formation, SANGRE-2; H.- *Deshayesites* cf. *deshayesi* LEYMERIE *in* d'ORBIGNY, 1841, Errenaga Formation, ERG-31-12; I.- *Deshayesites* cf. *consobrinoides* SINZOW, 1909, Errenaga Formation, ERG-18-7.

Description: three crushed specimens are to hand. Sides nearly parallel; ribs sharp and strong, sigmoidal near ventral area, primary ribs start from upper part of umbilical wall, secondary ribs are intercalated between primaries.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-18-7	28	11.5	0.41071	
Holotype	31	13	0.42	9.9
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
ERG-18-7	0	7	0.25	0
Holotype	0.32	9.6	0.31	0.76

Discussion: *Deshayesites consobrinoides* is characterised by the presence of smooth external sides in the early stages of ontogeny and is very similar to *Deshayesites deshayesi*, but possesses coarser ribbing. Another feature is that *Deshayesites consobrinoides* is more strongly evolute than average examples of *Deshayesites deshayesi* (CASEY, 1964).

Occurrence: Europe (CASEY, 1964), Russia (GLAZUNOVA, 1973), Caucasus (BOGDANOVA *et alii*, 1979), Turkmenistan (BOGDANOVA, 1999) and Iran (RAISOSSADAT, 2004).

Distribution: Igaratza section, Errenaga Formation (Figs. 6 - 7).

Deshayesites cf. *geniculatus* CASEY, 1964

Fig. 11 A

cf. 1964 *Deshayesites* cf. *geniculatus* sp. nov. CASEY; p. 307, pl. 46, fig. 5; pl. 51, fig. 9.

Holotype: British Geological Survey Museum, ZM 1937, Ferruginous Sands, Scaphites Beds, west of Whale Chine, Atherfield, Isle of Wight.

Material: ATAN-29, APAR-18.

Description: Whorl section sub-rectangular, whorl height is more than whorl width, thickest in the upper part of the flank; umbilical wall vertical. Ornament consists of ribs, thick, recurved backwards on the mid flank. Primary ribs start from upper part of the umbilical wall; secondaries are irregular and intercalated between primaries, start from mid to upper one third part of the flank, some fusing with adjacent primaries.

Measurements:

Sample Number	D	WH	WH/D	WT
ATAN-29		12		14
Holotype	37	11.8	0.31	10.3
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
ATAN-29				1.16
Holotype	0.27	10.7	0.28	0.87

Discussion: Occasional bifurcation might be a character for the species. *D. geniculatus* differs from *D. wiltshirei* CASEY, 1964, in its thick and curved ribbing. SPATH (1930) described the species as a transition form between *D. punfieldensis* and *D. vectensis* SPATH, 1930.

Occurrence: England (CASEY, 1964).

Distribution: Ataneta locality, Iribas section, Errenaga Formation (Fig. 6).

Deshayesites cf. *grandis* SPATH, 1930

Fig. 11 B

cf. 1930 *Deshayesites grandis* sp. nov.: SPATH, p. 427-429, pl. xvii, fig. 2a-b.

cf. 1961c *Deshayesites grandis* SPATH: CASEY, p. 508-510.

cf. 1964 *Deshayesites grandis* SPATH: CASEY, p. 308-309, pl. 43, figs, 1a-b; pl. 44, figs. 1-3; pl. 51, fig. 7a-b; text-fig. 110c.

cf. 2010 *Deshayesites grandis* SPATH: MORENO-BEDMAR *et alii*, fig. 11J, fig. V, B.

Holotype: British Geological Survey Museum, Geological Society collection 2300, from Atherfield (probably from Bed IV or V), CASEY said evidently from the Scaphites Beds (group V) of Atherfield (F. W. SIMMS collection).

Material: ER-136, ERG-8-3.

Description: Two crushed specimens. Ornament consist of ribs; primary ribs start from upper part of the umbilical wall, feebly curved; secondaries are irregular and intercalated between primaries, start from mid to upper one third part of the flank, most of them attached to primaries; all primary and secondary ribs are flattened and rounded in upper part of the flank.

Discussion: The only character for identification is rib pattern in the studied specimens. SPATH (1930) stated that the species is closer to *D weissi* than to *D. consobrinus*. The species is common in the type locality and a sub-zone is named on the occurrence of this species. SPATH believed that the species appears in the upper part of the *deshayesi* Zone and even occurs in the early Late Aptian. On the other hand, CASEY (1964) mentioned that *D. grandis* is limited to the *deshayesi* Zone and its record in the early Late Aptian is due to the confusing of large examples of *Dufrenoyia* with *D. grandis* by SPATH.

Occurrence: England (SPATH, 1930; CASEY, 1964).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

Deshayesites cf. *wiltshirei* CASEY, 1964

Fig. 11 C

cf. 1964 *Deshayesites wiltshirei* sp. nov.: CASEY, p. 305-306, pl. 53, fig. 4; pl 46, figs. 8-9; pl. 51, fig. 10.

cf. 1999 *Deshayesites* cf. *wiltshirei* CASEY: BOGDANOVA, p. 352, fig. 6.

Holotype: SEDGWICK Museum, Cambridge, B 27096, Ferruginous Sands, Atherfield, Isle of Wight (T. WILTSHIRE collection).

Material: ER-77, 81, 89, 101.

Description: Whorls sub-rectangular, sides flattened. Ornament consisting of primary and secondary ribs; primary ribs curved in mid part of the flanks, commence from upper part of

umbilical wall; secondary ribs start from upper one third part of the flank, intercalated between primaries mostly free at early whorls and some attach at last half whorl.

Discussion: The rib pattern is a character for identification. There is similarity between *D. wiltshirei* and *D. punfieldensis*, but the later species has a wider *umbilicus*, coarser ribs which are less flattened on the venter. Hitherto, the definitive species has not been recorded outside of England.

Occurrence: England (CASEY, 1964); Spain.

Distribution: Igaratza section, Errenaga Formation.

Deshayesites spp.

Fig. 9 K

A large number of crushed and juvenile specimens have been collected. Some of these are perhaps determinable at species level. The only importance of this material is that they are present in the *deshayesi-furcata* transition Zone discussed below.

Genus *Burckhardtites* HUMPHREY, 1949

Type species: *Neocomites nazasensis* BURCKHARDT, 1925

Generic characters: Discoidal, compressed, whorl height and width increasing during ontogeny. Sides and venter flattened with ventro-lateral shoulders. Ornament consists of primary sigmoidal ribs on the whorl flanks; secondary ribs are intercalated or branch from primaries. Ribbing is retrorsive on the lower part of the flank, convex forward near mid flanks and again convex backward on upper third of the flanks. On venter ribs are of uniform relief and nearly straight. Suture line seems to be of parahoplitid type.

Discussion: Fine and irregular ribs are characteristic for the genus. On the body chamber ribbing becomes very sharp. HUMPHREY (1949) introduced the genus for all forms of *Neocomites nazasensis* from the Aptian Rio Nazas, Mexico. However *Neocomites* disappeared in Hauterivian and it is believed *Burckhardtites* is more related to *Dufrenoyia*, than it is to *Neocomites* (WRIGHT *et alii*, 1996; BARRAGÁN & MAURASSE, 2008). *Burckhardtites* is probably derived from *Paradeshayesites* (BOGDANOVA & MIKHAILOVA, 2004). *Burckhardtites* differs from *Dufrenoyia* by lack of clear tubercles on the ventro-lateral bend, dense ribbing and sharp double S shaped ribs on the flanks.

Occurrence: Mexico (HUMPHREY, 1949; BARRAGÁN & MAURASSE, 2008), Turkmenistan (BOGDANOVA & MIKHAILOVA, 2004).

Burckhardtites sp.

Fig. 11 D

Material: ERG-34-7, 34-22

Description: Whorl section sub-rectangular, venter flat. Ornament consists of ribs, dense, fine and curved on flanks and nearly straight on venter; primary ribs originate from the umbilical margin, some single. Secondary ribs start from one-third of the lower flank or at the mid flank, intercalated and mostly attached to primary ribs. Twenty four primary ribs are present at thirty three mm diameter.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-34-7	34	15	0.44	
ERG-34-22	32	12	0.37	

Sample Number	WT/D	U	U/D	WT/WH
ERG-34-7	0	12	0.35	0
ERG-34-22	0	10.5	0.32	0

Discussion: The specimens occur in a *deshayesi* Zone assemblage. The rib patterns and number are interesting and similar to early deshayesitids. The specimens can be compared to HUMPHREY's figures of *Burckhardtites gregoriensis* (HUMPHREY, 1949, pl. 11, figs. 3-4) and it is suggested that this is the specific identity of the Aralar specimens. This species is recorded also from Turkmenistan (BOGDANOVA & MIKHAILOVA, 2004).

For a long time it has been assumed that *Burckhardtites* is limited to America, but the recent record from Turkmenistan shows that its distribution is more widespread within the Aptian Tethyan belt. The present record might allow us to determine the migration pattern of this genus from west to east of the Tethys.

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

Genus *Dufrenoyia* BURCKHARDT *ex* KILIAN & REBOUL, 1915

Type species: *Ammonites furcatus* SOWERBY *in* FITTON, 1836.

Generic characters: Semi involute, whorl section sub-rectangular to oval, with flattened and angular venter, umbilicus relatively wide; costation consists of ribs; primary ribs rise in the umbilicus margin, with light tuberculation, secondary ribs are intercalated, starting at the lower third or middle flank, most are free; ribs cross the venter isometrically, weak or disappearing on venter and forming denticulation on ventro-lateral shoulders. Suture line consists of four lobes, a bifid ventral lobe, an entire umbilical, inner lateral and dorsal lobe.

Discussion: The genus formerly considered to be a parahoplitid is now assigned to Deshayesitidae proposed by STOYANOW (1949). Interruption of ribs in the ventral area is good character for genus level identification. Ribs are thicker than *Deshayesites* in same diameter and are more regular.

The genus differs from *Deshayesites* in its flat venter, thicker more regular ribs and tubercles on ventro-lateral shoulder. The genus *Kuntziella* COLLIGNON, 1962, previously known as a subgenus of *Deshayesites*, shows similarity in some stage of growth with *Dufrenoyia*, but with

higher whorls, flatter sides and without marginal tubercles differs from later genus in the juvenile stage. The Early Albian homoeomorph genus *Neodeshayesites* (recently assigned to the subfamily Acanthohoplitinae by ROBERT & BULOT (2005) in its early stage of growth resembles *Dufrenoyia* but in its later stage of growth the venter is flattened with ribbing continuous across the venter with slight to moderate tuberculation at the ventro-lateral margins' *Stenhoplites* SPATH, 1923, is an objective synonym.

Occurrence: Europe, Russia, Turkmenistan, Iran, Japan, USA, Mexico, Venezuela and Colombia (HUMPHREY, 1949; STOYANOW, 1949; DRUSCHITZ & KUDRYAVTZEV, 1960; CASEY, 1964; BOGDANOVA, 1979; WRIGHT *et alii*, 1996; RAISOSSADAT, 2004; MORENO-BEDMAR *et alii*, 2010).

Dufrenoyia cf. *furcata* (SOWERBY, 1836)

Fig. 11 E-F

cf. 1836 *Ammonites furcatus* SOWERBY *in* FITTON, p. 339, pl. xiv, fig. 17.
cf. 1902 *Hoplites furcatus* SOWERBY: von KOENEN, p. 202.
cf. 1915 *Parahoplites* (*Duferonyia*) *furcatus* SOWERBY: KILIAN & REBOUL, p. 34.
cf. 1923 *Stenhoplites furcatus* (SOWERBY): SPATH, p. 147.
cf. 1925 *Dufrenoya furcata* (SOWERBY): BURCKHARDT, p. 17, pl. 10, figs. 12-13.
cf. 1940 *Dufrenoya furcata* (SOWERBY): SCOTT, p. 1021.
cf. 1949 *Dufrenoya furcata* (SOWERBY): HUMPHREY, p. 120-121.
cf. 1960 *Dufrenoya furcata* (SOWERBY): DRUSCHITZ & KUDRYAVTZEV, tab. 1, fig. 7.
cf. 1964 *Dufrenoyia furcata* (SOWERBY): CASEY, p. 378-382, pl. 62, figs. 2-3; pl. 63, fig. 1; pl. 65, fig. 1a-b; text-figs. 134d, 135-136 (see this reference for full synonyms before 1964).
cf. 1971 *Dufrenoyia furcata* (SOWERBY): BOGDANOVA, tab. 51, fig. 10.
cf. 1979 *Dufrenoyia furcata* (SOWERBY): BOGDANOVA, tab. 51, fig. 10.
cf. 1982 *Dufrenoyia furcata* (SOWERBY): RENZ, pl. 1, fig. 7.
cf. 1995 *Dufrenoyia furcata* (SOWERBY): KEMPER, taf. 2, fig. 2.
cf. 1999 *Dufrenoyia furcata* (SOWERBY): BOGDANOVA & PROZOROVSKY, pl. 8, figs. d-e.
cf. 2004 *Dufrenoyia furcata* (SOWERBY): BOGDANOVA & MIKHAILOVA, p. 219, pl. 12, figs. 1-3; text-fig. 28.
cf. 2010 *Dufrenoyia furcata* (SOWERBY): GARCÍA & MORENO-BEDMAR, p. 129, fig. 1, A-P2, fig. 2, A1-X, AA-AM.
cf. 2010 *Dufrenoyia furcata* (SOWERBY): MORENO-BEDMAR *et alii*, fig. 11, K, M; fig. VI, D-E; fig. VIII, D-E; fig. IX, A.

Holotype: British Geological Survey Museum, Geological society collection, Hythe Beds, Hythe, Kent (W.H. FITTON collection).

Material: ERG-34-14.

Description: Shell discoidal, whorl section is sub-rectangular to oval, truncated, forming angular ventro-lateral margins. Ornament consists of ribs; primary ribs rise in the umbilicus margin with light tuberculation; secondary ribs intercalate starting at mid- to upper part of the flank, most are free. Ribs cross the venter isometrically, feebly flattened in the upper part of the flank and ventral area, with feeble tuberculation on the ventral shoulders.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-34-14		13.5		11
Holotype	50	21	0.42	17
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
ERG-34-14				0.81
Holotype	0.34	17.5	0.35	0.80

Discussion: The flat venter and flattened ribs in the upper part of the flanks and ventral side are characteristic feature. *Dufrenoyia furcata* SOWERBY was confused with *Dufrenoyia dufrenoyi* d'ORBIGNY by some authors; full discussion is found in CASEY (1964). *D. furcata* differs from the latter species by possessing less overlapping whorls and coarser, sharp and broader ribs. *D. furcata* differs from *D. lurensis* KILIAN by its more involute whorls and less strong ribs (BOGDANOVA & MIKHAILOVA, 2004). The species is well known in Aptian successions in Tethys and a characteristic faunal element for the latest Early Aptian. It has been proposed as a zonal index on account of its geographically widespread occurrence (BOGDANOVA, 1979, 1983; BOGDANOVA & TOVBINA, 1994; KEMPER, 1995; HOEDEMAKER *et alii*, 1993, 1995, 2003).

Occurrence: England (CASEY, 1964), Germany (KEMPER, 1995), Russia (DRUSCHITZ & KULRYVTZVA, 1960), Turkmenistan (BOGDANOVA, 1979, 1999), USA (SCOTT, 1940; HUMPHREY, 1949).

Distribution: Igaratza section, Errenaga Formation (Fig. 7).

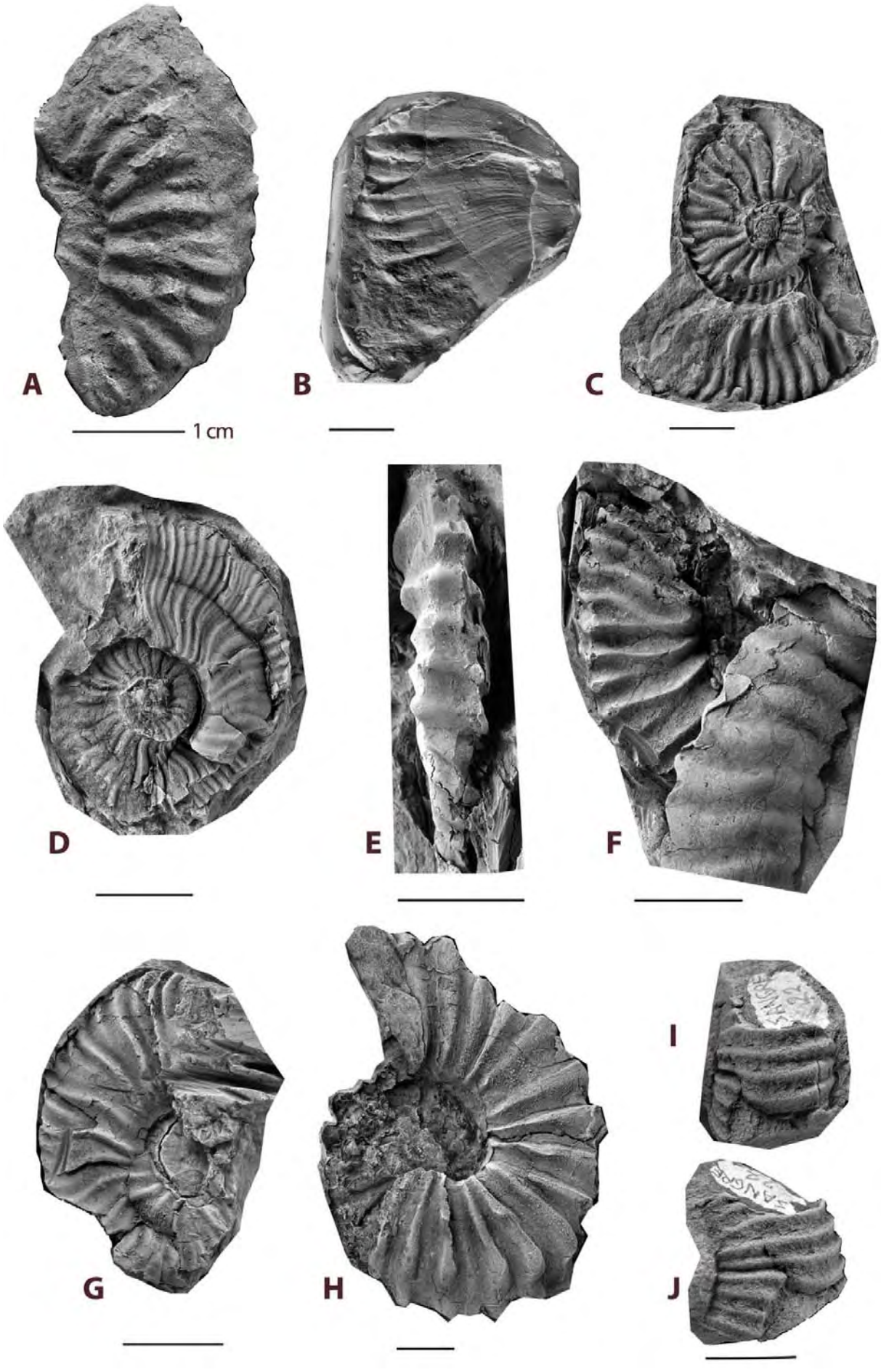
Dufrenoyia cf. *mackesoni* CASEY, 1964

Fig. 11 G

cf. 1964 *Dufrenoyia mackesoni* sp. nov.: CASEY, p. 397-398, pl. 52, fig. 4a-b; pl. 62, fig. 5a-b; pl. 65, fig. 4a-b; text-figs. 140d, 144.

Holotype: British Geological Survey Museum, 108189, Hythe Beds, Shepway Cross Quarry, Lympne, Kent (CASEY collection).

Figure 11: A.- *Deshayesites* cf. *geniculatus* CASEY, 1964, Errenaga Formation, ATAN-29; B.- *Deshayesites* cf. *grandis* SPATH, 1930, Errenaga Formation, ER-136; C.- *Deshayesites* cf. *wiltshirei* CASEY, 1964, Errenaga Formation, ER-77; D.- *Burckhardtites* sp., Errenaga Formation, ERG-34-7; E-F.- *Dufrenoyia* cf. *furcata* (SOWERBY, 1836), Errenaga Formation, ERG-34-14; G.- *Dufrenoyia* cf. *mackesoni* CASEY, 1964, Errenaga Formation, ERG-34-11; H.- *Dufrenoyia* cf. *lurensis* (KILIAN, 1888), Errenaga Formation, SANGRE-6; I.-J. *Toxoceratoides* ? sp., Lareo formation, SANGRE-22.


A
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Material: ERG-33-4, 33-5, 33-7, 34-11, SANGRE-17?

Description: Shell discoid, transverse section is sub-rectangular. Sculpture consists of ribs of narrow and moderate relief, curved; primary ribs start at the umbilical margin; intercalated secondary ribs start from mid-flank, most are free, the ribs form feeble denticulation on the ventral-lateral margin.

Measurements:

Sample Number	D	WH	WH/D	WT
ERG-33-7	42.5	18	0.42	
ERG-34-11	42.5	18	0.42	
Holotype	64	26.24	0.41	17.9
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
ERG-33-7	0	8	0.18	0
ERG-34-11	0	8	0.18	0
Holotype	0.2796	17.9	0.27	0.68

Discussion: The species differs from *D. predufrenoy* CASEY, 1964, by its weaker ribbing. There are similarities also between the *D. mackesoni* CASEY, 1964, and *D. stenzeli* HUMPHREY, 1949, the latter species possessing straighter ribs and a higher umbilical wall.

Occurrence: England (CASEY, 1964).

Distribution: Igaratza section, Errenaga Formation (Fig. 6).

Dufrenoyia cf. *lurensis* (KILIAN, 1888)

Fig. 11 H

cf. 1888 *Hoplites lurensis* sp. nov.: KILIAN, p. 681, pl. 20, fig. 2a-b.
cf. 1889 *Hoplites furcatus* Sowerby var. *lurensis*: KILIAN, p. 209.
cf. 1907 *Hoplites* (*Parahoplites*) *lurensis* KILIAN; JACOB, p. 354, 357.
cf. 1913 *Parahoplites lurensis* KILIAN: KILIAN, pl. 7, fig. 8a-b; pl. 10, fig. 5.
cf. 1925 *Dufrenoyia lurensis* (KILIAN): BURCKHARDT, p. 17.
cf. 1930 *Dufrenoyia lurensis* (KILIAN): SPATH, p. 436, pl. 15, fig. 4.
cf. 1940 *Dufrenoyia lurensis* (KILIAN): SCOTT, p. 1022.
cf. 1949 *Dufrenoyia lurensis* (KILIAN): HUMPHREY, p. 121, 124-125, p. 8, figs. 7-8 & 12-13.
cf. 1964 *Dufrenoyia lurensis* (KILIAN): CASEY, p. 382-383, pl. 63, fig. 2; pl. 64, figs. 3-4; text-figs. 137-140.

Holotype: From the Upper Aptian (Gargasian) of the Carniol (Basses Alpes), France (Sorbonne collection).

Material: SANGRE-6, 7

Description: Whorl section is sub-rectangular, becoming narrower towards the venter. Ornament consists of nearly straight ribs. Primary ribs rise in the upper part of umbilical wall, with light tuberculation. Secondary rib intercalation is rare. Ribbing commences at the lower part of the flank and cross the venter isometrically with ventro-lateral clavi, Shell flattened in the upper part of the flank and across the ventral area.

Measurements:

Sample Number	D	WH	WH/D	WT
SANGRE-6	62	20	0.32	14.5
SANGRE-7	43	16	0.37	
Holotype	42	15.9	0.37	15.9
Sample Number	**WT/D**	**U**	**U/D**	**WT/WH**
SANGRE-6	0.23	14.8	0.23	0.72
SANGRE-7	0	7	0.16	0
Holotype	0.37	15.1	0.35	1

Discussion: The form is similar to *D. furcata*, but differs from the latter in its more evolute whorls and coarser, less flexuous ribbing and fewer secondary ribs.

Occurrence: England (SPATH, 1930; CASEY, 1964), Germany (JACOB, 1907), France (KILIAN, 1889), Mexico (BURCKHARDT, 1925) and USA (SCOTT, 1940; HUMPHREY, 1949).

Distribution: Eskisable section, Ataun area, Lareo Formation (Fig. 6).

4. Ammonite biostratigraphy of the Aralar Early Aptian

Ammonites provide one of the most precise biostratigraphical tools for correlating marine Lower Cretaceous sediments. For much of Early Cretaceous time there was a separation into Tethyan and Boreal Realms, with distinct endemic ammonite faunas, which sometimes makes long-distance correlation difficult. However, some ammonite genera are of wide geographical distribution and this helps to resolve some of the correlation problems.

Because the Early Cretaceous ammonite successions of Western Europe have been studied in more detail than those in other areas of the world, the stage stratotypes are situated in this region and the ammonite zones proposed there are normally accepted as the "standard" biozonation. The Aptian Stage boundaries and index faunas in Europe have been discussed most recently by ERBA (1996) and by OWEN & RAISOSSADAT *in* GARCÍA-MONDÉJAR *et alii* (2009). Work by the Lower Cretaceous Cephalopod Team of the SCS has improved the standard biozonation for the Mediterranean area of the Tethyan Realm (HOEDEMAEKER *et alii*, 1990, 1993, 1995, 2000, 2003; RAWSON *et alii*, 1999, REBOULET *et alii*, 2006, 2009) (Table 1). In this section of the paper, the current division and biozonation of the Early Aptian sub-Stage will be discussed and an attempt is made to correlate successions throughout the whole of the northern Mediterranean Tethyan belt, stretching eastward to Iran.

5. Current definition and biozonation of the Early Aptian Stage

The Early Aptian ammonite zonation used here is that refined for the northern region of the Tethyan province (HOEDEMAEKER *et alii*, 2003; REBOULET *et alii*, 2006, 2009) (Table 1) and is relevant to the Spanish succession in Spain. This scheme embraces some of the Early Aptian deshayesitid zones first established in Mangyschlak (BOGDANOVA, 1971; BOGDANOVA &

TOVBINA, 1994; TOVBINA, 1968, 1980). A different ammonite zonation has been proposed by CASEY (1961c) and CASEY *et alii* (1998) for the succession in the Lower Greensand Group of southern and eastern England. This region belongs to a more Boreal province, but his scheme is applicable more widely in northern Europe and Greenland (*e.g.*, KELLY & WHITHAM, 1999) with some local modifications (*e.g.*, KEMPER, 1976). Both schemes for the Early Aptian reflect the occurrence of ammonite genera and species, particularly deshayesitids that are inter-provincial in their geographical range (*e.g.*, RAWSON, 1981; KOTETISHVILI, 1988; MEMMI, 1995, 1999; SEYED-EMAMI *et alii*, 1971; IMMEL *et alii*, 1997; RAISOSSADAT, 2004). The correlation of CASEY's scheme (CASEY, 1961c; CASEY *et alii*, 1998) with that of the Mediterranean Tethys has been discussed by OWEN & RAISOSSADAT *in* GARCÍA-MONDÉJAR *et alii* (2009) and is shown in Table 2.

Deshayesites oglanlensis Zone

CASEY (1961c) proposed a biozonation for the Early Aptian of England. In ascending order, the earliest Zone is that of *Prodeshayesites fissicostatus* divided into an earlier Subzone of *P. bodei* and a later *P. obsoletus* Subzone. These two subzones have been reported also from East Greenland (KELLY & WHITHAM, 1999). KEMPER (1995) considered that the species of *Prodeshayesites* are similar to species of *Deshayesites* reported from the *Deshayesites tuarkyricus* Zone of Turkmenistan by BOGDANOVA (1971, 1983). He considered *Prodeshayesites* to be a synonym of *Deshayesites* and this view is accepted here. Moreover it seems that the genera *Paradeshayesites* and *Obsoleticeras* of BOGDANOVA & MIKHAILOVA (1999) are subjective synonyms of *Deshayesites*. BOGDANOVA & TOVBINA (1994) correlated the *Deshayesites tuarkyricus* Zone (now *Deshayesites oglanlensis* Zone) in Turkmenistan with the *fissicostatus* Zone in England and the *tenuicostatus* Zone in Germany. RAISOSSADAT (2002) considered the geographical occurrence of *D. tuarkyricus* BOGDANOVA to be restricted to Mangyschlak (Turkmenistan) and Transcaspia. Therefore he suggested that the more geographically widespread species *D. oglanlensis* BOGDANOVA to be a more suitable index fossil for this Zone and this has been accepted (HOEDEMAEKER *et alii*, 2003; REBOULET *et alii*, 2006). Recently, *D. tuarkyricus* has been recorded in the Errenaga Formation in the Aralar Mountains (GARCÍA-MONDÉJAR *et alii*, 2009).

Deshayesites weissi Zone

CASEY (1961c) introduced a Zone of *D. forbesi* and divided it into four subzones; *D. fittoni*, *D. kiliani*, *D. callidiscus* and *D. annelidus* in ascending order. The *Deshayesites weissi* Zone was proposed for the roughly equivalent time period in the rest of Europe and the Mediterranean Tethyan belt. The *weissi* Zone has been identified in north Germany, Romania, the Balkans, Tuarkyr and Kopet Dagh (BOGDANOVA & TOVBINA, 1994). AVRAM (1999) believed the *forbesi* and *weissi* zones are only partially coeval and that the *weissi* Zone commences with the *callidiscus* Subzone of CASEY continuing to the base of the *grandis* Subzone of the *deshayesi* Zone of CASEY.

The author (*in* REBOULET *et alii*, 2006) considered that *D. weissi* is a *nomen dubium* and suggested, either to find a type from specimen of the SCHLOENBACH collection in Berlin (Germany) or to replace *D. weissi* with *Deshayesites planus* in the Standard zonation. These two species are found together in England as well as the rest of Europe in sediments of this age. This suggestion is under review.

Deshayesites deshayesi Zone

The *D. deshayesi* Zone of CASEY (1961c, 1964) and CASEY *et alii* (1998) is accepted by most authors (*e.g.*, BOGDANOVA, 1971, 1979; BOGDANOVA & TOVBINA, 1994; BOGDANOVA & PROZOROVSKY, 1999; DRUSCHITZ & KUDRYAVTZEV, 1960; DRUSCHITZ & GORBATSCHIK, 1979; HANCOCK, 1991; MEMMI, 1995, 1999; RAWSON, 1983; SHULGINA, 1996). CASEY (1961c), CASEY *et alii* (1998) suggested two subzones; an earlier *Cheloniceras* (*Cheloniceras*) *parinodum* CASEY, 1961b, and a later *D. grandis*. The co-occurrence of the first appearance of *D. deshayesi* and *Cheloniceras* (*Cheloniceras*) could be useful in the recognition of the *weissi* and *deshayesi* zones boundary. BOGDANOVA & PROZOROVSKY (1999) considered the *deshayesi* Zone in Transcaspia could be correlated with upper part of the English *deshayesi* Zone.

Dufrenoyia furcata Zone

Dufrenoyia is a widely distributed genus and *D. furcata* is the index fossil for the latest part of the Lower Aptian in the Mediterranean region. CASEY (1961a) suggested *Tropaeum bowerbanki* CASEY as the index species for the latest zone of the Lower Aptian in southern England, but *Dufrenoyia furcata* also occurs in that zone and *Tropaeum* is facies restricted.

6. Biozonation in study area

The vertical distribution of ammonites in the Errenaga and Lareo formations is shown in the range charts (Figs. 6 - 7 - 8). A representative sample of the ammonite fauna from the Aralar sections is illustrated in Figs. 5 - 9 - 10 - 11.

a. *Deshayesites oglanlensis* Zone

In the Errenaga Formation of Iribas section typical fauna of the *oglanlensis* Zone has been collected in-situ (assemblage 10, Fig. 3). The assemblage ammonite fauna (IRI-2 to 134) includes: *D.* cf. *oglanlensis* BOGDANOVA, 1983, *D.* cf. *tuarkyricus* BOGDANOVA, 1983, *D. weissiformis* BOGDANOVA, 1983, *D. luppovi* BOGDANOVA, 1983, *D. dechyi* PAPP, 1907, and *D.* cf. *antiquus*

BOGDANOVA, 1983.

The lowest occurrence of ammonites in the Errenaga Formation is in the Igaratza section at approximately one m above the base of the unit (assemblage 6, Fig. 3) and consists of an indeterminate *Deshayesites*. A zonal age cannot be determined, but the basal Errenaga Formation at Igaratza is Early Aptian and there is no evidence of the presence of Barremian sediments. The interval corresponds probably to the prolific fauna of *D. oglanlensis* Zone age found at Iribas.

No ammonites have been found in the lower part of the Errenaga Formation in the Ataun sections but an *oglanlensis* Zone age is probable on sedimentary subunit correlation evidence (Fig. 3). Higher in the lower part of the Formation, assemblage 1 (Figs. 3 - 4) at 185.0 m above the base of the section, contains a poorly preserved fauna (IMA-A-1 to 14) with *D.* cf. *weissiformis* and is probably of *oglanlensis* Zone age.

In the Aralar district, an *oglanlensis* Zone fauna is present at the lower part of the Errenaga Formation. The genus *Prochelonicera*s SPATH, 1923, occurs in the *oglanlensis* Zone throughout southern Europe. Although absent in the Aralar district, it has been recorded in sediments of this age in the Betic Cordillera of southern Spain (AGUADO *et alii*, 1997). This is of significance when considering the fauna of the succeeding *D. weissi* Zone at Aralar, discussed next.

b. *Deshayesites weissi* Zone

The best assemblage of ammonites is to be found in the Iribas and Igaratza sections (Fig. 7). At Iribas, a precise boundary between *oglanlensis* and *weissi* Zone faunas occurs at 23.85 m above the base of the unit (assemblage 11, Figs. 3 - 4). The *weissi* Zone material in this interval (ATAN-2 to 32, URG-1 & 2) contains *D.* cf. *weissi* NEUMAYR & UHLIG, 1881, *D. weissiformis* BOGDANOVA, 1983, *D.* cf. *planus* CASEY, 1961c, *D.* cf. *callidiscus* CASEY, 1961c, *D. dechyi* PAPP, 1907, *D.* cf. *geniculatus* CASEY, 1964, *D.* cf. *multicostatus* SWINNERTON, 1935, and *D. forbesi* CASEY, 1961c. A laterally equivalent outcrop situated 1 km West has yielded *Roloboceras* cf. *regale* CASEY, 1961c, and *Aconeceras* (*Aconeceras*) cf. *nisoides* (SARASIN, 1893), indicating a *weissi* Zone age (assemblage 12, Figs. 3 - 4).

Igaratza has provided the most important ammonite occurrence series within the *weissi* Zone (Fig. 7). The fauna includes *Deshayesites* cf. *bodei* (von KOENEN, 1902), *D. weissiformis* BOGDANOVA, 1983, *D.* cf. *euglyphus* CASEY, 1964, *D.* cf. *planus* CASEY, 1961c, *D.* cf. *callidiscus* CASEY, 1961c, *D. luppovi* BOGDANOVA, 1983, *D. dechyi* PAPP, 1907, *D. forbesi* CASEY, 1961c, *D.* cf. *multicostatus* SWINNERTON, 1935, *D.* cf. *saxbyi* CASEY, 1964, *D.* cf. *gracilis* SPATH, 1930, *D.* cf. *punfieldensis* SPATH, 1930, *D.* cf. *consobrinus* (d'ORBIGNY, 1841), *D.* cf. *grandis* SPATH, 1930, *D.* cf. *normani* CASEY, 1964, *Pseudosaynella* sp. and *Roloboceras* cf. *hambrovi* (FORBES, 1845); a typical *weissi* Zone fauna.

At a height of 256.0 m above the base at Ataun, IMA-1 to 17 (assemblage 2, Figs. 3 - 4) is of definite *weissi* Zone age and includes *D. forbesi*, *Aconeceras* (*Aconeceras*) cf. *nisoides*, *Aconeceras* (*Theganoceras*) sp.

In the Igaratza section, within a thickness of 20 m, the ammonite occurrences indicate successively the first appearance of the *D. weissi* Zone fauna, a typical *D. weissi* Zone assemblage, the *D. weissi*-*D. deshayesi* zones boundary and a relatively thin development of the *D. deshayesi* Zone. The distribution of the ammonites is shown in Fig. 7.

The view that the *weissi* and *forbesi* zones are coeval (BOGDANOVA & TOVBINA, 1994) is supported by the occurrences within the *weissi* Zone fauna in the Aralar area. This fauna includes: *D.* cf. *forbesi* CASEY, *D.* cf. *planus* CASEY, *D.* cf. *callidiscus* CASEY, *D. luppovi* BOGDANOVA, *D. dechyi* PAPP together with species of *Roloboceras* including *R.* cf. *hambrovi* (FORBES), and *R.* cf. *regale* CASEY. The occurrences of ammonite horizons in the Errenaga Formation are few and widely separated and thus, there are gaps in our knowledge of the ammonite succession in the Aralar area. However, in England, the genus *Roloboceras* is replaced by *Cheloniceras* (*Cheloniceras*) at the base of the *deshayesi* Zone (CASEY *et alii*, 1998). Based on above intrepretation the Aralar *weissi* Zone could be equivalent of the *D. callidiscus* Subzone only.

c. *Deshayesites deshayesi* Zone

A precise sediment boundary between the weissi and succeeding *deshayesi* zones is only recognisable at Igaratza (Fig. 7) where assemblage ERG-17 is of *weissi* Zone age and ERG-18, 0.29 m above at 100.13 m above the base of the section is of *deshayesi* Zone age. At Ataun, the boundary between sediments of the *weissi* and *deshayesi* zones cannot be given precision in the lack of ammonite evidence.

At Iribas, it is possible that the *deshayesi* Zone is represented in 2 metres of sediment upon equally condensed *weissi* Zone sediments if differences in subsidence and correlations of lithological subunits between the Iribas and Igaratza sections are taken into account (Fig. 4).

In the well-documented section at Igaratza (Fig. 7), *D.* cf. *deshayesi* appears as a rarity at 100.13 m (ERG-18-19) above the base of the section and then more commonly up to 104.53 m above the base. This interval of 4.4 m is classified only with the *deshayesi* Zone. The ammonites from this Zone at Igaratza (ERG-18-19 to ERG-28-10) include: *D.* cf. *deshayesi* LEYMERIE in d'ORBIGNY, 1841, *D.* cf. *callidiscus* CASEY, 1961c, *D.* cf. *consobrinus* (d'ORBIGNY, 1841), *D.* cf. *consobrinoides* SINZOW, 1909, *D.* cf. *planus* CASEY, 1961c, *D. dechyi* PAPP, 1907, *D.* cf. *multicostatus* SWINNERTON, 1935, *D.*

weissiformis BOGDANOVA, 1983, *D.* cf. *involutus* SPATH, 1930, and in the lower part of the succession include elements that have survived from the underlying *weissi* Zone.

The sediments of the *D. deshayesi* Zone typically are thinly represented in the upper part of the Errenaga Formation (Fig. 4). I take the base of the Zone at the first appearance of *D. deshayesi*, but it is difficult determination of specimens in the upper part of the Errenaga Formation and in the Lareo Formation above the Sarastarri Limestone due to the co-occurrence of *Deshayesites* and *Dufrenoyia* (Figs. 6 - 7 - 8). Elsewhere in Europe, sediments of the *deshayesi* Zone are characterised by species of *Deshayesites* only and the transitions to *Dufrenoyia* are absent. Sediments of the succeeding *Dufrenoyia furcata* Zone yield *Dufrenoyia* only, *Deshayesites* being absent (*e.g.*, CASEY, 1960; CASEY *et alii*, 1998). This suggests that the earliest part of the *furcata* Zone with its transitional fauna is not represented by sediments over much of the European region although detailed collecting in the Vocontian Basin (France) and the Cau Section (SE Spain) (AGUADO *et alii*, 1997) may show a similar transitional interval. Thus, the Aralar succession in Europe is currently unique and reflects the extremely rapid accumulation of sediments during this relatively brief period of time.

<table>
<tr><th rowspan="2">Sub-Stage</th><th colspan="2">Standard biozonation</th><th rowspan="2">Proposed Biozonation (Aralar)</th><th colspan="2" rowspan="2">Assemblage fauna</th></tr>
<tr><th>SE England (CASEY, 1961c; HANCOCK, 1991)</th><th>Mediterranean Region (HOEDEMAEKER et alii, 2003; REBOULET et alii, 2009)</th></tr>
<tr><td rowspan="4">Lower Aptian</td><td>Deshayesites deshayesi</td><td>Deshayesites deshayesi</td><td>Deshayesites cf. deshayesi - Dufrenoyia cf. furcata transition</td><td rowspan="2">Deshayesites and Dufrenoyia coexistence</td><td>Aconeceras cf. nisoides, Aconeceras haugi, Burckhardtites sp., Deshayesites cf. consobrinus,D. cf. consobrinoides, D. cf. deshayesi, cf. geniculatus, D. cf. involutus, D. cf. multicostatus, D. cf. normani, D. cf. punfieldensis, D. spp., Dufrenoyia cf. mackesoni, Dufrenoyia cf. furcata, Hemihoplites sp., and Toxoceratoides sp.</td></tr>
<tr><td rowspan="2">Deshayesites forbesi</td><td rowspan="2">Deshayesites weissi</td><td>Deshayesites cf. deshayesi</td><td>Aconeceras haugi, Aconeceras cf. nisoides, Deshayesites cf. callidiscus, D. cf. consobrinus, D. cf. consobrinoides, D. dechyi, D. cf. deshayesi, D. forbesi, D. cf. involutus, D. cf. multicostatus, D. cf. planus, D. weissiformis, D. spp., and Roloboceras cf. hambrovi</td></tr>
<tr><td>Deshayesites cf. weissi</td><td colspan="2">Aconeceras (Aconeceras) cf. nisoides, Deshayesites cf. bodei, D. cf. callidiscus, D. cf. consobrinus, D. dechyi, D. cf. euglyphus, D. forbesi, D. cf. geniculatus, D. cf. gracilis, D. cf. grandis, D. luppovi, D. cf. multicostatus, D. cf. normani, D. cf. planus, D. cf. punfieldensis, D. cf. weissi, D. weissiformis, D. cf. saxbyi, Pseudosaynella sp., and Roloboceras cf. regale</td></tr>
<tr><td>Prodeshayesites fissicostatus</td><td>Deshayesites oglanlensis</td><td>Deshayesites cf. oglanlensis</td><td colspan="2">Deshayesites cf. oglanlensis, D. cf. tuarkyricus, D. weissiformis, D. luppovi, D. dechyi, and D. cf. antiquus, Pseudosaynella sp., Aconeceras (Theganoceras) sp., and Roloboceras cf. hambrovi</td></tr>
</table>

Table 2: Comparison of the Early Aptian ammonite biozonation in SE England, Mediterranean Region and Aralar (N Spain).

d. *Deshayesites deshayesi* - *Dufrenoyia furcata* Zone transition

The ammonite fauna in the Igaratza section includes *Dufrenoyia mackesoni* CASEY, 1964, which first appears in the succession at 104.53 m above the base, where it is associated with species of *Deshayesites*. A similar association of ammonites occurs a little higher in the section (ERG-34) (Fig. 4) and in the Lareo Formation throughout the Aralar region. Such an association is unique in the known sections in Europe spanning the *deshayesi-furcata* zones boundary. Elsewhere in Europe, there is a distinct changeover in the ammonite fauna at the base of *furcata* Zone sediments with *Dufrenoyia* replacing *Deshayesites*. The rapid sedimentation in the Aralar region reflecting the Biscay marginal subsidence has preserved the transition between the two zones. *Dufrenoyia* is clearly related to *Deshayesites*, but hitherto, the transitional forms have not been found.

The Aralar succession provides this transitional interval in a very thick sediment succession. Within the Errenaga succession at Igaratza, *Dufrenoyia furcata* (SOWERBY, 1836), the zonal index of the *furcata* Zone, appears in ERG-34 at 104.82 m above the base of the section associated with *Deshayesites* cf. *deshayesi* LEYMERIE *in* d'ORBIGNY, 1841, *D.* cf. *involutus* SPATH, 1930, and *Burkhardites* sp. among others listed in Fig. 7. The Errenaga Formation was deposited in an open shelf environment with a local basinward polarity from east to west. Towards the top of the Errenaga Formation in the *Deshayesites deshayesi-Dufrenoyia furcata* zones transition, a new regressive episode is deduced from the emplacement of shallow-water carbonate platform facies of the Sarastarri Formation (Fig. 4).

Deshayesites species	Spain	France	Romania	Caucasus	Turkmenistan	Iran (Kopet Dagh)	England
D. bodei (VON KOENEN)	x (cf.)			x		---	
D. callidiscus CASEY	x (cf.)	x			x	---	x
D. consobrinoides SINZOW	x (cf.)	x			x	x (cf.)	x
D. dechyi PAPP	x (cf.)	?	---	x	x	x (cf.)	---
D. deshayesi d'ORBIGNY	x (cf.)	x		x	x	x	x
D. euglyphus CASEY	x (cf.)	x	---	?	---	x (cf.)	x
D. forbesi CASEY	x (cf.)		x	?	---	---	x
D. geniculatus CASEY	x (cf.)					---	x
D. gracilis CASEY	x (cf.)		x			---	x
D. grandis CASEY	x (cf.)	?	---	---	---	---	x
D. involutus SPATH	x (cf.)	?	x	---	---	x (cf.)	x
D. luppovi BOGDANOVA	x (cf.)	x	x	?	x	x	---
D. multicostatus SWINNERTON	x (cf.)	x?	x	x	---	x (cf.)	x
D. oglanlensis BOGDANOVA	x (cf.)	x	x	?	x	x	---
D. planus CASEY	x (cf.)	?	x	---	x	x (cf.)	x
D. punfieldensis SPATH	x (cf.)	?	---	---	---	---	x
D. saxbyi CASEY	x (cf.)					---	x
D. tuarkyricus BOGDANOVA	x (cf.)	---	---	---	x	x (cf.)	---
D. weissi NEUMAYR & UHLIG	x (cf.)	x	x	x	x	x	?
D. weissiformis BOGDANOVA	x (cf.)	x	x	?	x	x (cf.)	---

Table 3: Comparison of Deshayesites species of the north Spain and other areas in the Mediterranean Province.

The co-occurrence of *Deshayesites* and *Dufrenoyia* in this transitional interval might eventually be recognised as a distinct Subzone, to be indexed when more extensive ammonite material is available. At the top of the Errenaga Formation at Igaratza *Dufrenoyia* is rare and does not become more common until the Lareo Formation above.

The lower boundary of the *furcata* Zone is taken at the base of the Lareo Formation. This would probably be the boundary in other areas of more incomplete ammonite record. Strictly, its base should be taken at its first appearance in the Igaratza section in sample ERG-33 at 104.53 m. Elsewhere in Europe and Iran, *Deshayesites* does not occur in the *furcata* Zone ammonite fauna (*e.g.*, CASEY, 1961c; CASEY *et alii*, 1998; RAISOSSADAT, 2004). The succession in the Vocontian Basin in France (*e.g.*, MAGNIEZ-JANNIN *et alii*, 1997), Switzerland (STRASSER *et alii*, 2001) and Spain (AGUADO *et alii*, 1997; CASTRO *et alii*, 2001) for this interval is not controlled by ammonites as precisely as in Aralar (GARCÍA-MONDÉJAR *et alii*, 2009).The co-occurrence of *Deshayesites* and *Dufrenoyia* in this transitional interval might eventually be recognised as a distinct Subzone, to be indexed when more extensive ammonite material is available.

The first Deshayesitidae (*Turkmeniceras*) appeared in the Late Barremian of the restricted region of the Kopet Dagh and Turkmenistan, while its descendant, *Deshayesites,* spread to the Caucasus, Europe and even Greenland.

The Lower Aptian ammonite biozonation based on species of *Deshayesites* and its descendent genus *Dufrenoyia* in north Spain discussed here is widely applicable throughout the Mediterranean Tethyan belt from northern Spain eastward to the Kopet Dagh region of Iran and Turkmenistan. The assemblage fauna in the *D. oglanlensis* Zone of the Aralar Mountains resembles that of France and the Kopet Dagh. Moreover this Tethyan Zone can be correlated with the *Prodeshayesites fissicostatus* Zone of northern Europe proposed by CASEY (1961c). The next ascending ammonite biozone is based on the stratigraphic distribution of *Deshayesites weissi* and *Deshayesites planus*. The *weissi* Zone has long been established, however *D. planus* shows a greater geographical dispersion than *D. weissi*. The next ascending Zone is based on the widespread occurrence of *D. deshayesi* and is a long established zonal index species for the later Early Aptian. It is capable of widespread recognition in the European shelf seas as well as in the Tethyan belt. The successor of *Deshayesites, Dufrenoyia* also has a cosmopolitan distribution. The genus is more widely distributed than *Deshayesites*, especially to the west, where it occurs also in North America and the northern part of South America where *Deshayesites* is absent or recorded only questionably. *Deshayesites* species in north Spain show the closest similarity to those species recorded from Turkmenistan and Iran (Kopet Dagh), France, Romania and Caucasus. Among twenty identified species from north Spain, twelve species are common with Iran and Turkmenistan (Kopet Dagh), and nearly the same number of species with England, whereas seven species are shared with France and Romania (Table 3). This indicates good marine connections permitting the

widespread distribution of these species and enabling the palebiogeographic interpretation of the Mediterranean Province.

7. Conclusions

The Lower Aptian in Aralar is subdivided into the Errenaga, Sarastarri and Lareo formations. Representative species of the following genera: *Aconeceras, Pseudosaynella*, *Toxoceratoides?* sp., *Hemihoplites*, *Roloboceras*, *Deshayesites*, *Dufrenoyia* are identified and described for first time from study area. Based on ammonite assemblage fauna *D. oglanlensis*, *D. weissi*, *D. deshayesi* biozones and an important *D. deshayesi-D. furcata* transitional interval in which *Deshayesites* and *Dufrenoyia* co-exist is suggested. The latter is currently unique to the Aralar succession and has important implications for the current global biostratigraphical correlations which need thorough revision.

The *Deshayesites* species of the Aralar Mountains resembles that of France, Romania, Caucasus, Kopet Dagh and England. It is capable of widespread recognition in the Tethyan belt as well as in the European shelf seas. This indicates good marine connections in above areas and could use in the paleobiogeographic interpretation of the Mediterranean Province.

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