

The Late Lower Albian Invertebrate Fauna of the Río Hatillo Formation of Pueblo Viejo, Dominican Republic

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ABSTRACT.—The Río Hatillo Formation outcrops in the region of Pueblo Viejo, in the Cordillera Central of Dominican Republic, is composed of clastic deposits in the lower part and massive, biogenic limestones in the upper part. This formation overlies unconformably the vulcano-sedimentary Los Ranchos Formation and represents deposits of the Volcanic Arc domain. The fossils mostly consist of poorly preserved fragmentary internal moulds. We provide the first comprehensive description of invertebrates, especially ammonites, from the Río Hatillo Formation. The taxa identified are ammonites - *Phylloceras* (*Hypophylloceras*) cf. *seresitense* Pervinquièrre, *Protetragonites aelosus aelosus*, *Tetragonites* cf. *nautiloides*, *Tetragonites* cf. *rectangularis*, *Kossmatella* (*Kossmatella*) cf. *romana*, *Beudanticeras* cf. *laevigatum*, *Douvilleiceras* cf. *mammillatum*; belemnite: *Neohibolites* cf. *minimus*; pelecypods: *Venilicardia* sp. and *Ostrea* cf. *ameghinoi* rocana; gastropod *Cerithium* cf. *heeri*, one brachiopod *Kingena* sp., and echinoderms: *Holactypus* sp., *Holaster* sp., and *Hyposalenia* sp. This association yields a general Western Tethys affinity, equivalent to the Mammillatum Zone (Late Lower Albian) of Europe. The age of the Río Hatillo Formation was previously identified as Aptian through Cenomanian and the Los Ranchos Formation as Neocomian. We identify the invertebrate fauna of the base of the Río Hatillo Formation as Late Lower Albian. The age of the underlying Los Ranchos Formation is extended to the Neocomian through Aptian interval. The marine invertebrates here investigated suggest that the Caribbean was an active marine seaway during the Albian, providing the dispersion of the marine faunas between the Western Tethys and the Pacific Ocean.

KEYWORDS.—paleontology, biostratigraphy, Lower Cretaceous, Lower Albian, fossil invertebrate, Dominican Republic

INTRODUCTION

The Río Hatillo Formation includes a basal conglomerate, sandstones and calcareous sandstones covered by massive biogenic limestone. The formation overlies unconformably the altered vulcanogenic and sedimentary rocks of the Los Ranchos Formation (Bowin 1966; Russell and Kesler 1991). The Río Hatillo fossil-bearing rocks were deposited in a rather shallow near shore environment as suggested by the presence of the plant remains and scars of superficial currents. This environment contrast with of the underlying Los Ranchos Formation which was deposited in terres-

trial to costal volcanic island conditions (Russell and Kesler 1991; Iturralde-Vinent and MacPhee 1999). The latter is the older land environment reported from the Cretaceous volcanic arc of the Caribbean region (Iturralde-Vinent and MacPhee 1999).

Based on the foraminifers, Bowin (1996) assumed the age of the biogenic limestone as probable Aptian to Albian. Albian or Cenomanian echinoderms-*Holactypus* Desor, *Conulus* Lambert, *Holaster* L. Agassiz, *Salenia* Gray, *Cardiaster* Forbes, *Pygopyrina* Pomel and *Hemiaster* Desor (Kier in Russell and Kesler 1991)-were reported from the basal part of the unit. However, base on the mollusks the limestone of the Río Hatillo Formation (Kaufman 1976, Sohl 1976; Skelton and Rojas in: Iturralde-Vinent 1997) was dated as Middle Albian age. From the dark grey limestone of this for-

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mation were collected the rudists *Coelcomana ramosa* Boehm of Lower Albian age and a few Albian primitive *Caprinuloidea* (personal information P. W. Skelton 2004).

The fauna assemblage described herein was collected from the clastic rocks within the lower part of Río Hatillo Formation by N. Russell (personal communication, 1997). They were collected in the limestone quarry located within the perimeter of the mine in Pueblo Viejo area, Dominican Republic (Fig. 1, Russell and Kesler 1991). Members of the Board of Direction of the Gold Mine Rosario Dominicana S.A. gave these fossils to the junior author. The fossils are from the lower part of the Río Hatillo Formation in the Pueblo Viejo area. All the fossils described herein were identified by the senior author. The invertebrates herein described are housed in the paleontologic collection of the National Museum of Natural History in Havana, Cuba (MNHNCu). In this paper we describe only ammonites, belemnites, a gastropod (*Ceritium* sp.) and a bivalve (*Ostrea* sp. cf. *ameghinoi rocana*) and use the classifications of Wright et al. (1996). Additional fossil materials, probably of the same taxa here described, but yet unidentified, is treasured at the headquarters of Rosario Dominicana S.A. The

identified fauna contained eight ammonites, two bivalves, one gastropod and one brachiopod and three echinoderms. The fauna is composed by: ammonites (~54.5%), belemnites (~27.3%), gastropods (~2.3%), bivalves (~4.5%), brachiopods (~2.3%) and echinoderms (~9.1%) mainly preserved as altered internal moulds except for the oysters that yield incomplete shells. The poor preservation complicated the identification of the taxa and several were determined with doubt. The molds do not present any taphonomic indications suggesting redeposition, and the alteration of the fossils is probably the result of diagenesis related to the karstic dissolution of the rocks as a whole.

The age of the Río Hatillo and Los Ranchos Formations

The invertebrate specimens *Beudanticeras* cf. *laevigatum* (Sowerby), *Douvillieceras* cf. *mammillatum* Schlotheim and *Coelcomana ramosa* Boehm, collected in the basal part of the Río Hatillo Formation, suggest a Late Lower Albian age. This date puts into question the age of the underlying Los Ranchos Formation. The Neocomian age of Los Ranchos Formation is based on two facts: (1)

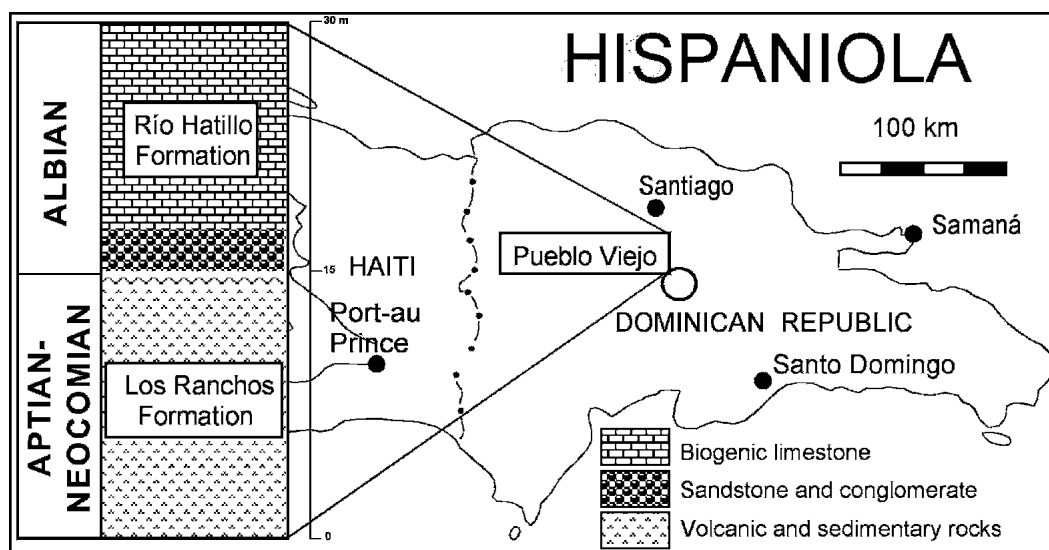


FIG. 1. Map of the Dominican Republic with lithologic scheme of the Los Ranchos and Río Hatillo Formations in the Pueblo Viejo area.

the fossils plants identified as *Brachyphyl-lum* by C. J. Smiley (in Russell and Kesler 1991; Smiley 2002) from Pueblo Viejo and El Platanal members of Los Ranchos Formation; and (2) between Los Ranchos and Río Hatillo there is an angular unconformity (Bowin 1966; Russell and Kesler 1991). We herein propose that these criteria do not exclude the possibility that the upper members of the Los Ranchos Formation could be Aptian, and the formation as a whole represent a Neocomian through Aptian interval. This assumption is confirmed by recent radiometric dates of the Los Ranchos Formation (Kesler et al. 2005)

The ammonites described here suggest the following age and ammonite zones (named in conform with the international convention, see Salvador 1994): *Phylloceras* (*Hypophylloceras*) cf. *seresitense* Pervinquière – occurs at the Upper Aptian trough Cenomanian, *Protetragonites aelosus aelosus* (d'Orbigny), *Tetragonites* cf. *nautiloides nautiloides* (Pictet), *Tetragonites* sp. cf. *rectangularis* Wiedmann, *Kossmatella* (*Kossmatella*) cf. *romana* Wiedmann all occur in the Albian, *Beudanticeras* cf. *laevigatum* (Sowerby) occurs in the Lower - Middle Albian (within the Mammillatum and lower part of the Dentatus Zones), and *Douvilleiceras* cf. *mammillatum* Schlotheim – indicates the Mammillatum Zone.

Other invertebrate fossils as: *Neohibolites* cf. *minimus* (Miller) - Middle to Upper Albian; *Venilicardia* sp. (Lower Cretaceous – Recent, see Murray 1985); *Cerithium* sp. cf. *heeri* Pictet et Renevier (Aptian, Weaver 1931); *Kingena* sp. (Albian – Maastrichtian, Murray 1985), and (?*Holectypus* sp., *Holaster*

sp., *Hyposalenia* sp., - Albian, Murray 1985) found in Río Hatillo support this conclusion. The subspecies *Ostrea ameghinoi rocana* Von Ihering found by Weaver (1931) together with ammonites of the genus *Baculites* (Upper Cretaceous - Turonian to Maastrichtian) of Argentina, is not useful for the determination of the age of the Río Hatillo Formation, because the whole range of the Von Ihering's subspecies is not explained.

The invertebrate fossils as indicators of marine connections

The ammonite assemblage of the Río Hatillo Formation yields a general Western Tethys affinity (Wiedmann 1973; Marciniowski and Wiedmann 1990; Kennedy et al. 1997). It corresponds to the equivalent of the European Lower Albian Mammillatum Zone (see Salvador 1994; Fig. 2).

In western Cuba (Havana province), an assemblage of Albian through Cenomanian ammonites occurs in limestone boulders of the Campanian Río Piedras conglomerate (Albear and Myczyński 1984). These ammonite-bearing boulders were probably derived from the Cretaceous Volcanic Arc section equivalent to the one that occurs in Dominican Republic (Iturralde-Vinent 1997).

The presence of *N.* cf. *minimus* (Miller) in the basal conglomerates of the Río Hatillo Formation is remarkable because belemnites are uncommon in the Jurassic and Cretaceous deposits of the Caribbean area. But the genus *Neohibolites* (*minimus* group) was reported by Seibertz and Spaeth (2000) from the Albian of Puebla (Southern

STAGE	SUBSTAGE	TETHYDIAN AMMONITE ZONES (after Hoedemaeker <i>et al.</i> , 1993)
ALBIAN	UPPER	Dispar
		Inflatum
	MIDDLE	Lautus
		Loricatus
		Dentatus
	LOWER	Mammillatum
		Tardefurcata

FIG. 2. Stratigraphical scheme after Kenedy et al. (1997).

Mexico). The rudist *Coalcomana ramosa* Boehm, found in the Río Hatillo Formation, is also reported from Lower Albian volcanic arc deposits of Puerto Rico (Sohl 1976), the Western Tethys and from Mexico and Texas (Barrera and Johnson 1999). The gastropod *Cerithium* (Fig. 5-7) is also listed from the Middle Albian rocks of Mexico by Buitrón-Sánchez and Gómez-Espinosa (2003).

The presence of invertebrate assemblages of Albian age with the same ammonites and other marine invertebrate taxa in sedimentary rocks intercalated within the volcanic arc sections of Puerto Rico, Hispaniola, Cuba, and in Mexico and Texas, suggest that, in the Albian, these regions were connected by the sea. Furthermore, as during the Albian the Cretaceous volcanic arc was probably located along the Pacific margin off the Caribbean region (Kerr et al. 1999; Pindell and Kennan 2001), this strongly suggests that, at that time, the Caribbean was a seaway between the western Tethys and the Pacific Ocean, providing the possibility of marine faunal dispersion. This conclusion confirms previous suggestions based on correlation of gastropods (Sohl and Kollmann 1985; Buitrón-Sánchez and Gómez-Espinosa 2003), rudists (Rojas et al., 1995; Barrera and Johnson 1999); and in the general paleogeographic characteristics of the Caribbean (Iturralde-Vinent and MacPhee 1999).

Conclusions

- 1) The invertebrate fossil assemblage of the lower part of the Río Hatillo Formation can be dated as Late Lower Albian, and correlated with the Mammillatum ammonite Zone.
- 2) The ammonite assemblage of the Río Hatillo Formation presents Western Tethyan affinities.
- 3) The underlying Los Ranchos Formation can be dated as Neocomian through Aptian in age.
- 4) The Río Hatillo Formation was deposited in a shallow, near-shore environment as part of the Cretaceous Volcanic Arc sections. This Volcanic Arc, during the Albian, was probably located off the Caribbean, facing the Pacific Ocean.
- 5) The marine invertebrates here investigated suggest that the Caribbean was an active marine seaway during the Albian, providing the dispersion of the marine faunas between the Western Tethys and the Pacific Ocean.

SYSTEMATIC PALEONTOLOGY

The following measurements were used to describe ammonites: D – maximum diameter in mm; Wh – whorl height in mm; Wb – width of whorl; U – umbilical diameter; Wh/D – whorl height/shell diameter; U/D – umbilical diameter/shell diameter; Wb/Wh – whorl breadth/whorl height.

AMMONITES

Order Ammonoidea Zittel, 1884
 Suborder Phylloceratina Arkell, 1950
 Superfamily Phyllocerataceae Zittel, 1884
 Family Phylloceratidae Zittel, 1884
 Subfamily Phylloceratinae Zittel, 1884
 Genus *Phylloceras* Suess, 1865

In this paper the systematic revision of phylloceratids by Wiedmann (1964) is adopted.

Subgenus *Hypophylloceras* Salfeld, 1924

Type species: *Phylloceras onoense* Stanton, 1895

Diagnosis: Compressed with sub-parallel flanks, finely ribbed, some with periodic stronger ribs or folds. Sutures complex, lobes asymmetric, large and finely divided.

Occurrence: The subgenus *Hypophylloceras* is cosmopolitan (occurrence in Europe, South Africa and Venezuela), and ? Tithonian, Valanginian to Maastrichtian in range (Renz 1982; Marcinowski and Wiedmann 1990).

Discussion: Wiedmann (1964) distinguished three groups of species and subspecies of the subgenus *Hypophylloceras* on the basis of differences in shape section, sculpture and the shape of suture line.

Phylloceras (*Hypophylloceras*) cf. *seresitense*
 Pervinquier, 1907
 (Fig. 3: 1 - 5, 10)

1907. *Phylloceras Velledae* var. *Seresitensis*
 Pervinquier p. 52

1968. *Phylloceras* (*Hypophylloceras*) *sere-*

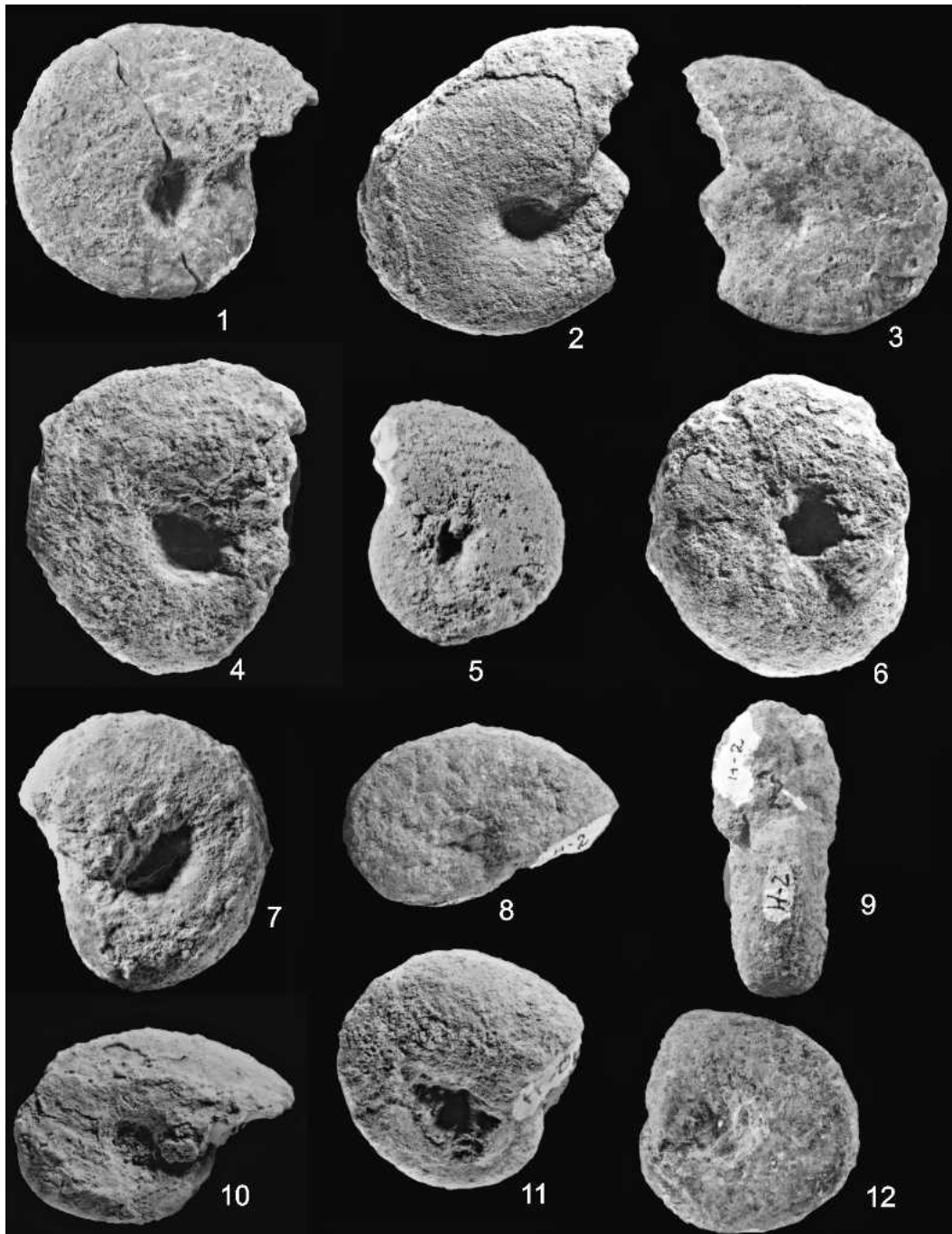


FIG. 3. 1 - 5, 10 - *Phylloceras* (*Hypophylloceras*) cf. *seresitense* Pervinquière; 1 - (specimen 16/MNHNCu-P3593, x 1,25); 2, 3 - (22/MNHNCu-P3591, x 2); 4 - (specimen 6/MNHNCu-P3595, x 2); 5 - (23/MNHNCu-P3599, x 2,5); 10 - (15/MNHNCu-P3592, x 2); Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 6, 7, 11, 12 - *Tetragonites* cf. *nautiloides* (Pictet); 6 - (specimen 7/MNHNCu-P927, x 1,8); 7 - (5/MNHNCu-P923, x 1,5); 11, 12 - (specimen 8/MNHNCu-P924, x 1,5); 8, 9 - *Tetragonites* cf. *rectangularis* Wiedmann; specimen 2/MNHNCu-P3633, x 1; Río Hatillo Formation, Dominican Republic, Upper Lower Albian.

sitense seresitense Pervinquier; Renz, p. 17-18; Pl. 1, Fig. 1.

1968. *Phylloceras* (*Hypophylloceras*) *seresitense seresitense* Pervinquier; Wiedman and Dieni, p. 26.

1974. *Phylloceras* (*Hypophylloceras*) *seresitense seresitense* Pervinquier; Marciniowski, p. 167, Pl. 31, Fig. 2 a-c.

1994. *Phylloceras* (*Hypophylloceras*) *seresitense* Pervinquier; Kennedy, p. 216, Pl. 2, Figs. 1-4, 16, 17.

1996. *Phylloceras* (*Hypophylloceras*) *seresitense seresitense* Pervinquier; Gale et al., p. 544, fig. 10g; 12 a - e, l, k, n, o.

Specimens examined:

6/-P3595, D-21, Wh-11, Wb-9, U-, Wh/D-52%, Wb/D-42%, Wb/Wh-81%, U/D-; 15/P3592, D-22.5, Wh-11, Wb-9, U-1.5, Wh/D-48%, Wb/D-40%, Wb/Wh-81%, U/D-6%; 16/MNHNCu-P3593, D-41.5, Wh-22.5, Wb-17, U-3, Wh/D-54%, Wb/D-40%, Wb/Wh-75%, U/D-7%; 22/MNHNCu-P3591, D-31, Wh-15, Wb-12, U-2.5, Wh/D-48%, Wb/D-38%, Wb/Wh-, U/D-8%; 23/MNHNCu-P3599, D-16, Wh-9.5, Wb-6.5, U-1, Wh/D-53%, Wb/D-40%, Wb/Wh-68%, U/D-6%; 24/MNHNCu-P3600; D-12.5, Wh-7.0, Wb-5.0, U-1.0, Wh/D-56%, Wb/D-40%, Wb/Wh-71%, U/D-8%; 26/MNHNCu-P3597; D-10, Wh-5.0, Wb-4.5, U-0.8, Wh/D-50%, Wb/D-45%, Wb/Wh-90%, U/D-8%.

Descriptions: Involute, smooth shell of small to middle size (10 to 41.5 mm), with ovate whorl section. The flanks are flattened. Small umbilicus. The suture is not visible.

Occurrence: *Phylloceras* (*Hypophylloceras*) *seresitense* is known from the Upper Aptian to the Cenomanian of France, Spain, Northern Africa, Balearic Islands, Southern Africa (Zululand), Madagascar, India and Alaska and Mexico (Kennedy 1994; Gale, 1996). In the Pueblo Viejo area, the specimens were found in the lower part of the

Río Hatillo Formation (pers. inform. of N. Russell) the Upper Lower Albian age.

Discussion: According to the form (ovate whorl section and small umbilicus) and dimensions of the shell, these specimens resemble the ones of the *Phylloceras* (*Hypophylloceras*) *seresitense* Pervinquier species, presented in the papers cited in the synonymy. Altered form of the preservation and small dimension of the specimens make impossible observe characteristic for this species fine ornament of the shell. The poor preservation they were attributed to this taxon with reserves.

Suborder Lytoceratina Hyatt, 1889

Superfamily Lytocerataceae

Neumayr, 1875

Family Lytoceratidae Neumayr, 1875

Subfamily Lytoceratinae Neumayr, 1875

Genus *Protetragonites* Hyatt, 1900

Type species: *Ammonites quadrisulcatus* (d'Orbigny, 1850)

Diagnosis: Circular whorl section; few constrictions straight to slightly curve.

Occurrence: Upper Jurassic (Upper Tithonian) – Lower Cretaceous (Valanginian) of Europe.

Discussion: The genus *Protetragonites* Hyatt, 1900 is broadly considered by Wiedmann (1962 b), i.e., including the genera *Leptotetragonites* Spath, 1927 and *Hemitetragonites* Spath, 1927.

Protetragonites aelosus aelosus

(d'Orbigny, 1850)

(Fig.4: 8 a)

1850. *Ammonites Aelosus* d'Orbigny, p. 125.

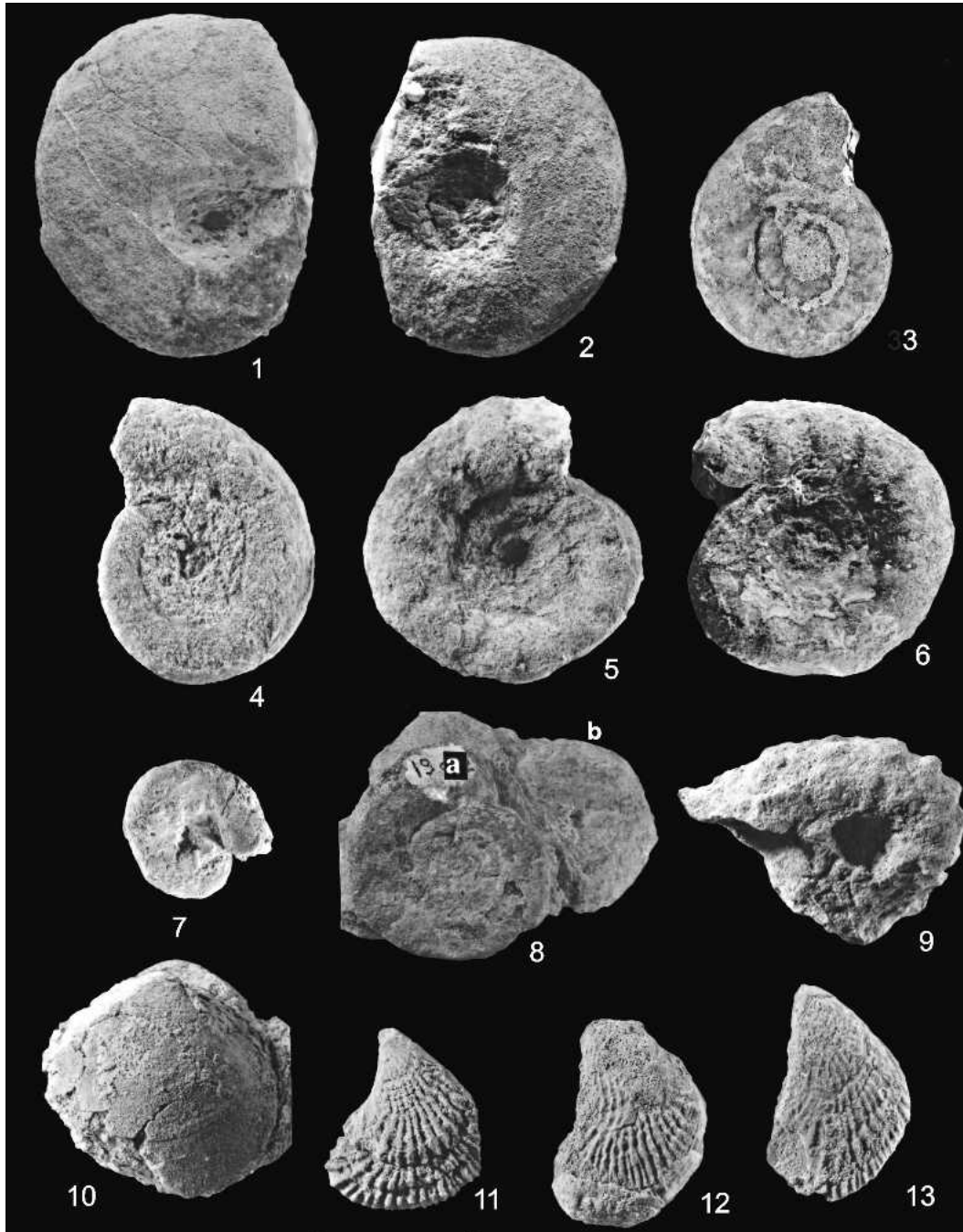
FIG. 4. 1, 2 - *Tetragonites* cf. *rectangularis* Wiedmann; specimen 1/MNHNCu-P3632, x 1; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 3 - 6 - *Kossmatella* (*Kossmatella*) *romana* Wiedmann; 3 - 4 specimen 10/MNHNCu-P3623, x 2; 5 - 6 specimen 9/MNHNCu-P3628, x 2,5; Río Hatillo Formation, Dominican Republic, Lower Albian; 7 - *Tetragonites* cf. *nautiloides* (Pictet); specimen 9/MNHNCu-P926, x 1; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 8 a, b - a - *Protetragonites aelosus aelosus* (d'Orbigny), specimen 19a/MNHNCu-P920, x 1; b - *Beudanticeras* cf. *laevigatum* (Sowerby), specimen 19 b/MNHNCu-P920, x 1; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 9 - *Douvilleiceras* cf. *mammillatum* (Schlotheim); specimen 12/MNHNCu-P3635, x 1, Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 10 - *Venilicardia* sp., specimen 39/MNHNCu-P3637, x 2; Río Hatillo Formation, Dominican Republic, Lower Albian; 11 - 13 - *Ostrea* sp. cf. *ameghinoides* *rocana* Von Ihering; 11 - specimen 40/MNHNCu-P3640, x 1,5; 12 - specimen 41/MNHNCu-P3613, x 1,5; 13 - specimen 42/MNHNCu-P3641, x 1,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian.

1962b. *Protetragonites aelosus aelosus* (d'Orbigny); Wiedmann, p. 24, pl. 10, fig. 3, text-figs. 6, 24 (with synonymy).

1990. *Protetragonites aelosus aelosus* (d'Orbigny); Marcinowski and Wiedmann, p. 25, Pl. 1, Fig. 8, Text-fig. 24.

1996. *Protetragonites aelosus aelosus* (d'Orbigny); Gale et al., p. 544, Figs. 135, f.

1997. *Protetragonites aelosus aelosus* (d'Orbigny); Kennedy, Billote & Hansotte, p. 463, Pl. 2, Figs. 2, 6, 8, 10; Pl. 10, Fig. 6; Pl. 11, Fig. 13.



Specimen examined:

19a/MNHNCu-P920 D-38, Wh-11.2, Wb-9.5, U-18.3, Wh/D-39.4, Wb/D-25%, Wb/Wh-85%, U/D-48.1%

Description: Shell evolute, serpenticonic and smooth. It shows approximately four constrictions in each whorl. Flanks slightly swollen. The ventral part of the shell is rounded, but not very wide. Umbilicus wide and shallow. The ornamentation is not preserved.

Occurrence: *Protetragonites aelosus aelosus* (d'Orbigny, 1850) is known from the condensed strata of the Albian in Southern France and Poland (Gale et al. 1996).

Discussion: This specimen is very similar to *Protetragonites aelosus aelosus* (d'Orbigny 1850) described and illustrated by Marcinowski and Wiedmann (1990) and others authors mentioned in the synonymy, especially by the evolute, serpenticonic form of the shell, constrictions and dimensions. In our specimen, typical radial ornamentation of the shells could not be observed.

Genus *Kossmatella* Jacob, 1907
Genus and Subgenus *Kossmatella*
Jacob, 1907

Type species: *Ammonites agassizianus* Pictet, 1847

Diagnosis: Depressed or oval whorl section with large lateral bulges. Subgenus group ammonites *Kossmatella* Jacob with weakened lateral ornamentation (Wiedmann, 1962 a).

Occurrence: Cosmopolitan, Upper Aptian – Cenomanian of Europe, Sinai, India, California, Texas and Mexico.

Kossmatella (Kossmatella) romana

Wiedmann, 1962

(Fig. 4: 3 - 6; Fig. 5: 4)

1962 a. *Kossmatella (Kossmatella) romana* Wiedmann, p. 164, pl. 8, fig. 6, pl. 13, fig. 12, text-figs. 21 - 24 (with synonymy)

1968. *Kossmatella (Kossmatella) romana* Wiedmann; Wiedmann & Deni, p. 38,

Pl. 1, Figs. 10, 11; Pl. 2, Fig. 7; Pl. 3, Fig. 10.

1990. *Kossmatella (Kossmatella) romana* Wiedmann; Marcinowski and Wiedmann, p. 28, Pl. 2, Fig. 7.

1997. *Kossmatella (Kossmatella) romana* Wiedmann; Kennedy, Bilotte & Hansotte, p. 464, Pl. 6, Figs. 1-3, 11-13.

1997. *Kossmatella (Kossmatella) romana* Wiedmann; Delamette, Charollais, Decrouez and Caron, p. 370, Pl. 40, Fig. 4.

Specimens examined:

MNHNCu-P3628 D-22.5, Wh-7, Wb-8, 5 U-10, Wh/D-31%, Wb/D-37%, Wb/Wh-121%, U/D-44%; 10/MNHNCu-P3623 D-22, Wh-8, Wb-7, U-9.5, Wh/D-36%, Wb/D-31%, Wb/Wh-87%, U/D-43%; 11/MNHNCu-P3625, D-36, Wh-13 Wb-10, U-16 Wh/D-36%, Wb/D-27%, Wb/Wh-76%, U/D-44%; 21/MNHNCu-P3624 D-?45, Wh-13, Wb-10, U-16 Wh/D-36%, Wb/D-27%, Wb/Wh-76%, U/D-44%; 25/MNHNCu-P3629 D-?34, Wh-14, U-?15, Wh/D-41%, U/D-?44%

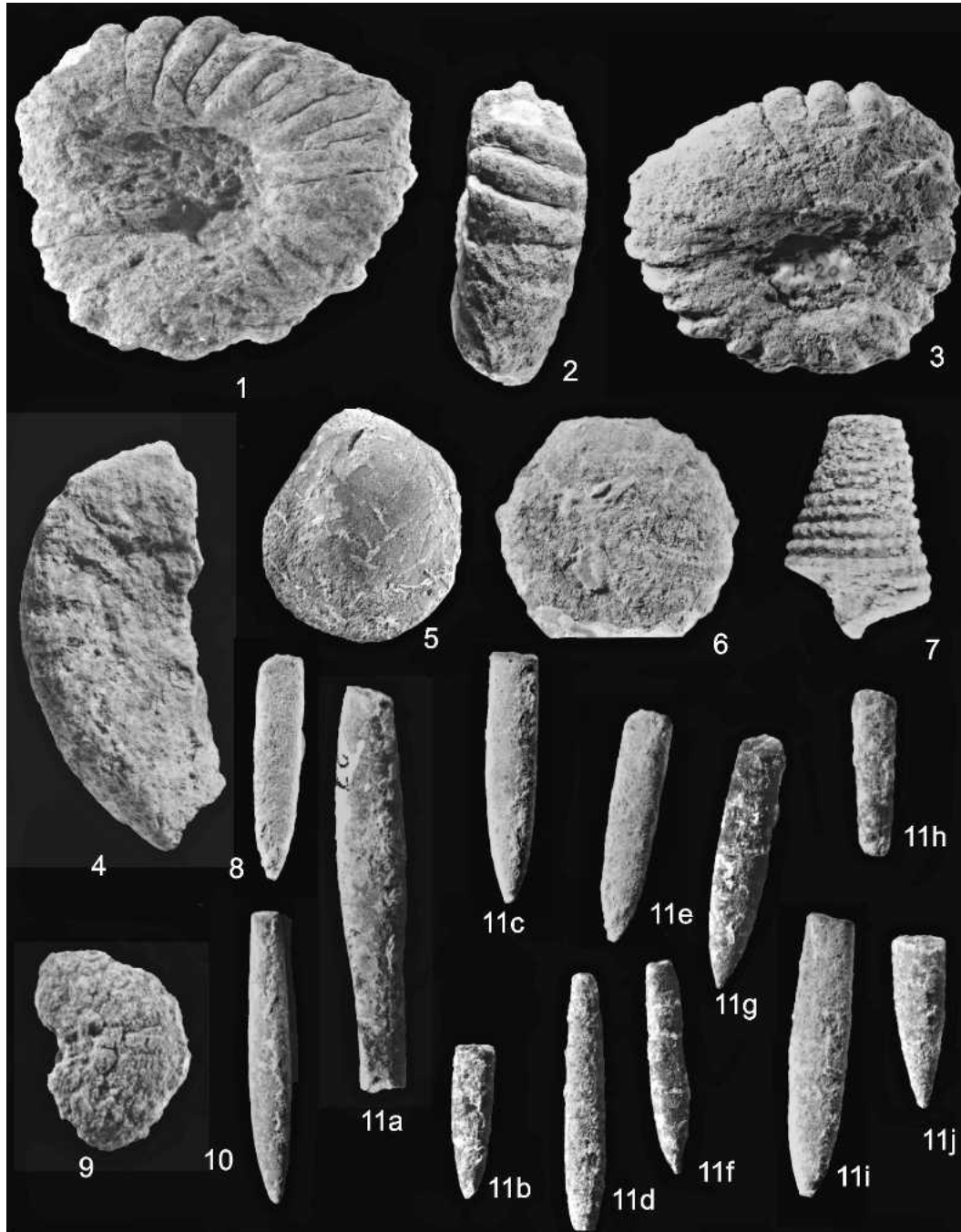
Description: Evolute, serpenticonic shell, with polygyral coiling, and subovate whorl section. The ventral part is rounded. The flanks are widest at mid-flank. Umbilicus is wide and shallow. The flanks bear characteristic radial bulges, separated by deep constrictions. The bulges (15 in per whorl) began at the umbilical margin.

FIG. 5. 1 - 3 - *Douvilleiceras cf. mammillatum* (Schlotheim); specimen 20/MNHNCu-P3634, x 1, Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 4 *Kossmatella (Kossmatella) romana* Wiedmann, specimen 10/MNHNCu-P3623, x 2; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 5 - *Kingenia* sp., specimen 43/MNHNCu-P928, x 1,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 6 - *Hyposalenia* sp., specimen 44/MNHNCu-P3638, x 2,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 7 - *Cerithium cf. heeri* Pictet et Renevier, specimen 45/MNHNCu-P3620, x 4; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 8 - *Neohibolites minimus* (Lister), specimen 33/MNHNCu-P3604, x 1,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 9 - *Hyposalenia* sp., specimen 46/MNHNCu-P920, x 2,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 10 - *Neohibolites minimus* (Lister), specimen 28/MNHNCu-P3612, x 1,5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian; 11a-j.—*Neohibolites minimus* (Lister), specimens: a - j 27/MNHNCu-P3605; 29-32/MNHNCu-P3606, MNHNCu-P3606, MNHNCu-P3603, 34 to 38/MNHNCu-P3615, MNHNCu-P3602, MNHNCu-P3616, MNHNCu-P3614, MNHNCu-P3608, 1, 5; Río Hatillo Formation, Dominican Republic, Upper Lower Albian.

Occurrence: The species *Kossmatella* (*Kossmatella*) *romana* Wiedmann is known from the condensed strata of the Albian in Southern Germany, France, Sardinia, Spain and Poland (Marcinowski and Wiedmann

1990). Our specimens were found together with other fauna described here in the lower part of the Río Hatillo Formation.

Discussion: Despite the bad preservation, the main features of the studied specimens,



such as the subcircular aspects of the whorl section and the approximate 15 bulges per whorl, make it similar to *Kossmatella* (*Kossmatella*) *romana* Wiedmann.

Superfamily Tetragonitaceae Hyatt, 1900
Family Tetragonitidae Hyatt, 1900
Subfamily Tetragonitinae Hyatt, 1900
Genus *Tetragonites* Kossmat, 1895

Type species: *Ammonites timotheanus* Pictet, 1848.

Diagnosis: Moderately evolute; whorl section trapezoidal, rectangular or rounded; oblique constrictions usually present. Suture line with auxiliaries and 4 saddles.

Occurrence: Cosmopolitan (occurrence in Europe, Sinai, Japan, India, Texas, Mexico). Uppermost Aptian to Maastrichtian, see Wiedmann (1973).

Discussion: Based on the presence of the constrictions, Wiedmann (1973) differed in the genus *Tetragonites* Kossmat two main groups: *T. rectangularis* group (constrictions are present) and *T. timotheanus* group (constrictions present only on early stages).

Tetragonites cf. *nautiloides* (Pictet, 1847)
(Fig. 3: 6, 7, 11, 12; Fig. 4: 7)

1847. *Ammonites timotheanus* var. *nautiloides* Pictet, p. 296, pl. 3, fig. 2.

1968. *Tetragonites nautiloides* (Pictet); Wiedmann and Deni, p. 47, pl. 4, figs. 7, 10.

1973. *Tetragonites* cf. *nautiloides nautiloides* (Pictet); Wiedmann, p. 606, pl. 8, figs. 2, 5-8, Text-fig. 10.

1990. *Tetragonites nautiloides* (Pictet); Marcinowski and Wiedmann, p. 31, pl. 1, figs. 12, 13, Text-fig. 17.

Specimens examined:

3/MNHNCu-P922, D-?20, Wh-?12, Wb-?15, U-?3, Wh/D-?42%, Wb/D-53%, Wb/Wh-125%, U/D-?15%; 4/MNHNCu-P925, D-21.5, Wh-?11.5, Wb-12, U-3, Wh/D-53%; Wb/D-55%, Wb/Wh-104%, U/D-13%, 5/MNHNCu-P923, D-33, Wh-16, Wb-15, U-5.3, Wh/D-48%, Wb/D-45%, Wb/Wh-93%, U/D-16%; 7/MNHNCu-P927, D-34, Wh-17, Wb-26, U-8, Wh/D-50%, Wb/D-76%, Wb/Wh-152%, U/D-23%; 8/MNHNCu-P924, D-24, Wh-12, Wb-18, U-6, Wh/D-50%, Wb/D-75%, Wb/Wh-150%,

U/D-25%; 9/MNHNCu-P926, D-?20, Wh-, Wb-17.5, U-, Wh/D-, Wb/D-87%, Wb/Wh-, U/D-.

Description: Involute shell of small size, with a trapezoidal whorl section. The flanks are narrow and slightly flattened. Small umbilicus. Both, the suture and the constrictions, are not visible.

Occurrence: *Tetragonites nautiloides* (Pictet) is known from the Upper Albian of Western Europe and rarely reported from the Lower to Middle Albian of Southern France and Mallorca (Wiedmann 1973) and the Albian condensed section of Poland (Marcinowski and Wiedmann 1990). The specimens described here were collected with other ammonites in the lower part of the Río Hatillo Formation.

Discussion: According to the shape of the shell and dimensions these specimens are similar to *Tetragonites nautiloides* (Pictet) illustrated in the papers cited in the synonymy.

Tetragonites cf. *rectangularis*
Wiedmann, 1962a
(Fig. 3: 8, 9; Fig. 4: 1, 2)

1962 a. *Tetragonites rectangularis* Wiedmann, p. 178, pl. 14, fig. 3; text-fig. 39 (with synonymy).

1966. *Tetragonites* cf. *rectangularis* Wiedmann, 1962b; Kennedy in Gale et al., p. 546, figs 11a-c; 12 l, 13 h (with additional synonymy).

Specimens examined:

1/MNHNCu-P3632, D-83, Wh-39, Wb-42, U-23, Wh/D-46%, Wb/D-50%, Wb/Wh-107%, U/D-27%; -2/MNHNCu-P3633, D-35, Wh-16, Wb-18, U-?7, Wh/D-45%, Wb/D-51%, Wb/Wh-112%, U/D-?20%.

Description: Involute shell of middle size, with a rectangular whorl section of the inner whorls and subtrapezoidal body chamber. The ventral part and the flanks of the shell are flattened in the inner whorls and somelike ovate in the body chamber. Umbilicus quite wide but not very deep. The suture and constrictions were not observed.

Occurrence: The species *Tetragonites rectangularis* Wiedmann is known from the Albian in Southwestern Europe, the United

Kingdom, Poland and Madagascar (Marcinowski and Wiedmann 1990). The specimens described here were collected in lower part of the Río Hatillo Formation.

Discussion: According to the form and dimensions of the shell, these specimens are very similar to specimens of *Tetragonites rectangularis* Wiedmann, described and illustrated by Wiedmann and Dieni (1968, p. 47, Pl. 4, Fig. 8), Wiedmann (1973, p. 596, Pl. 1, Fig. 1, Pl. 4, Fig. 2, Pl. 7, Figs. 1, 2); Marcinowski and Wiedmann (1990, p. 30, Pl. 1, Fig. 11, - Text-fig. 16). Because the studied material is poorly preserved, it can not be attributed to this species with complete certainty, besides the fact they have no constrictions, a feature which is common in the *Tetragonites nautiloides* (Pictet) group.

Suborder Ancyloceratina Wiedmann, 1966
Superfamily Douvilleicerataceae Parona et Bonarelli, 1897

Family Douvilleiceratidae Parona et Bonarelli, 1897

Subfamily Douvilleiceratinae Parona et Bonarelli, 1897

Genus *Douvilleiceras* Grossouvre, 1894

Type species: *Ammonites mammillatus* Schlotheim, 1813 pro parte

Diagnosis: Round, polygonal or depressed whorl section. Ribs with strong umbilical, and ventrolateral tubercles of equal or varying strength which are later lost.

Occurrence: Cosmopolitan, Lower – Middle Aptian of Europe, Sinai, India, Madagascar USA, Peru, Colombia.

Discussion: Our specimens represent forms with not very visible umbilical tubercles.

Douvilleiceras cf. *mammillatum*
(Schlotheim, 1813)
(Fig. 4: 9; Fig. 5: 1–3)

1813. *Ammonites mammillatus* Schlotheim, p. 111.

1930. *Douvilleiceras mammillatum* Schlotheim; Passendorfer, 651.

1965. *Douvilleiceras mammillatum* (Schlotheim) ? var. *aequinodum* (Quenstedt); Howarth, p. 343, Pl. 1, Figs. 1–4.

1990. *Douvilleiceras mammillatum* (Schlotheim); Marcinowski and Wiedmann, p. 51, pl. 7, figs. 5, 6.

1997. *Douvilleiceras mammillatum mammillatum* (Schlotheim); Kennedy, Bilotte and Hansotte, p. 469, pl. 6, figs. 8, 17–19.

Specimens examined:

12/MNHNCu-P3635, D-?28, Wh-14, Wb-12, U-8.5, Wh/D-50%, Wb/D-42%, Wb/Wh-86%, U/D-30%; 20/MNHNCu-P3634, D-?61, Wh-25 Wb-34, U-20, Wh/D-40%, Wb/D-50%, Wb/Wh-85%, U/D-32%.

Description: The specimen 12/MNHNCu-P3635 is an evolute shell of small size (about 28 mm) with an ovate whorl section. The ventral part of the shell is rounded with a moderately marked seam in its middle part. The flanks are rounded and flattened. The widest part is located in the middle part of the whorl. Umbilicus of medium size. The ornamentation consists of ribs that are strong in the beginning and later least visible with umbilical and ventrolateral tubercles. In the medium of the whorl there are six umbilical and ventrolateral tubercles. The specimen 20/MNHNCu-P3634 is an evolute shell of large size (about 61 mm), deformed, with a wide and deep umbilicus. The ribs are strong, wide in their ventral part, simple and divided with small, not very visible umbilical tubercles. The interrib spaces are narrower than the ribs.

Occurrence: The specimens described here were collected together with the other ammonites of the Río Hatillo Formation. The species *Douvilleiceras mammillatum* (Schlotheim) is known from the upper part of the Lower Albian of England, France, Switzerland, Germany, Poland, Turkmenistan, Kazakhstan, Pakistan, South Africa and Madagascar (Kennedy et al. 1997). The specimens were collected of lower part of the Río Hatillo Formation.

Discussion: According to the form and dimensions of the shell these specimens are very similar to the species *Douvilleiceras mammillatum* (Schlotheim) illustrated in the papers cited in the synonymy. Particularly the specimen 20/MNHNCu-P3634 is very similar to the form that was illustrated by (Howarth, 1965, p. 343, Pl. 1, Fig. 4a-b) and described as *Douvilleiceras mam-*

millatum (Schlotheim) ? var. *aequinodum* (Quenstedt).

Suborder Ammonitina Hyatt, 1889
Superfamily Desmocerataceae Zittel, 1895
Family Desmoceratidae Zittel, 1895
Subfamily Beudanticeratinae
Breistroffer, 1953
Genus *Beudanticeras*, Hitzel, 1902

Type species: *Ammonites beudanti* Brongniart, 1822

Diagnosis: Moderately involute, compressed, sides convex to flat, venter narrowly arched but not acute. Smooth or with weak ribs. Sinuous constrictions present or not.

Occurrence: Lower – Upper Alb of Europe, Sinai, Queensland, Japan, Texas, Patagonia, Greenland. Our specimens were collected of lower part of the Río Hatillo Formation.

Discussion: The specimens from Río Hatillo Formation represents ammonites with flattened and smooth flanks.

Beudanticeras cf. *laevigatum*
(J. de C. Sowerby, 1827)
(Fig. 4: 8b)

1827. *Ammonites laevigatus* J. de C. Sowerby, p. 93, pl. 549, fig. 1.

1997. *Beudanticeras laevigatum* (Sowerby); Delamette et al., p. 334, pl. 22, fig. 7.

1997. *Beudanticeras laevigatum* (J. de C. Sowerby); Kennedy, Bilotte y Hansotte, p. 465, pl. 10, fig. 7.

Specimens examined:

19b/MNHNCu-P920, D-35 Wh-18, Wb-10, U-3, Wh/D-51%, Wb/D-28%, Wb/Wh-55%, U/D-8%; 13/MNHNCu-P921, D-32, Wh-17, Wb-9, U-4, Wh/D-53%, Wb/D-28%, Wb/Wh-53%, U/D-12, 5%.

Description: Discoidal shell of medium size and a triangular whorl section. The ventral part of the shell is narrow and rounded, with its largest width in the umbilical edge. The flanks are flattened and smooth. Umbilicus of small size. The suture is not visible.

Occurrence: *Beudanticeras laevigatum* (Sowerby) is known from the zone of *Douvilleiceras mammillatum*, from the Lower Al-

bian of the United Kingdom and France, and from the lower part of the zone *Hoplites dentatus* from the Middle Albian of France (Kennedy et al. 1997).

Discussion: According to the form and dimensions of the shell these specimens are very similar to the specimens of *Beudanticeras laevigatum* (Sowerby) illustrated in the papers quoted in the synonymy. Our specimens have been distinguished from *Beudanticeras beudanti* (Brongniart) by a narrower shell and umbilicus, as well as by the lack of strong ornamentation.

BELEMNITES

Subclass Dibranchiata Owen, 1832
Order Decapoda Leach, 1818
Suborder Belemnnoidea Naef, 1912
Family Belemnitidae d'Orbigny, 1845
Subfamily Hastatinae Stolley, 1919
Genus *Neohibolites* Stolley, 1911

Type species: *Belemnites semicanaliculatus* De Blainville, 1827

Diagnosis: Small guard with well-developed lateral lines. Ventral furrow confined to lateral region.

Occurrence: Aptian – Cenomanian of Europe, Asia and Americas (Murray, 1985)

Discussion: Genus very frequent in Albian.

Neohibolites cf. *minimus* (Lister, 1678)
(Fig. 5: 8, 10, 11)

1930. *Neohibolites minimus* (Lister); Passendorfer, p. 509, pl. IV, fig. 81a-f.

1959. *Neohibolites minimus* (Miller); Cieśliński, p. 27, fig. 9

1968. *Neohibolites minimus* (Lister), Wiedmann and Dieni, p. 157, pl. 17, figs. 5, 11.

Specimens examined:

12 fragments of rostrum: (27 to 38; L – length of rostrum, W – width of rostrum); MNHNCu-P3605, L – 43 mm, W – 15 mm), MNHNCu-P3612, L – 31 mm, W – 5 mm), MNHNCu-P3609, L – 24 mm, W – 8 mm), MNHNCu-P3606, L – 30 mm, W – 15 mm), MNHNCu-P3607, L – 23 mm, W – 4 mm), MNHNCu-P3603, L – 26 mm, W – 5 mm), MNHNCu-P3604, L – 27 mm, W – 6 mm), MNHNCu-P3615, L – 24 mm, W – 5 mm),

MNHNCu-P3602, L – 16 mm, W – 4 mm), MNHNCu-P3604, L – 27 mm, W – 6 mm), MNHNCu-P3616 L – 17 mm, W – 4 mm), MNHNCu-P3614 L – 14 mm, W – 4 mm), MNHNCu-P3608 L – 13 mm, W – 5 mm).

Description: These are small forms with an average length of 20 to 30 mm. The largest specimen reaches 43 mm. The form of the rostrum is elongated cylinder. The alveolar part is rounded.

Occurrence: The specimens described herein were collected from the Río Hatillo Formation together with the ammonites. The species *Neohibolites minimus* (Lister) is known from the Middle to Upper Albian of the Mexico, United Kingdom, France, Germany and Russia (Cieśliński 1959; Wiedmann and Dieni 1968).

Discussion: These specimens are similar to the specimens of *Neohibolites minimus* (Lister) illustrated in the papers quoted in the synonymy. The small size is characteristic for this species. The poor preservation does not allow a definite classification of these specimens.

BIVALVIA

Class Bivalvia Linné, 1758
Order Pterioidea Newell, 1965
Superfamily Ostreoidea, Rafinesque, 1815
Family Ostreidae Lamarck, 1815
Genus *Ostrea* Linné, 1758

Type species: *Ostrea edulis* Linné, 1758

Diagnosis: Outline variable (usually orbicular); shells generally flattish, low beaks directed dorsally; cardinal areas high and triangular. Left valve with rounded radial ribs. Right valve flat with lamellar concentric growth ridges. Lateral denticulation present.

Occurrence: Cretaceous – Recent. World-wide.

Discussion: Jurassic ostreas are located in the genus *Liostrea* Douvillé, 1904.

Ostrea sp. cf. *ameghinoi rocana* Von Ihering (fig. 4: 11, 12, 13)

1931. *Ostrea ameghinoi rocana* Von Ihering; Weaver, p. 87, pl. 60, figs. 378 – 381; pl. 61, figs. 386-395.

Specimens examined:

40/MNHNCu-P3640, 41/MNHNCu-P3613, 40/MNHNCu-P3641.

40/MNHNCu-P3640 – L – length of the shell – 20 mm, W – wide of the shell – 15 mm, H – height of the shell – 9 mm; 41/MNHNCu-P3613 – L – 23 mm, W – 17 mm, H – 8 mm; 40/MNHNCu-P3641 – L – 25 mm, W – 16 mm, H – 8 mm.

Description: Small shell, shape triangular, not very inflated, slightly convex with robust radial ribs and lamellar, concentric, growth ridges. The low beak slightly convex forwards but not twisted.

Occurrence: Upper Cretaceous (? Turonian – Maastrichtian) of Argentina. The specimens described herein were collected in the lower part of the Río Hatillo Formation, together with the Upper Lower Albian ammonites.

Discussion: Our material consists of only left valves. According to the form, dimensions, and ornamentation of the shell, these specimens are similar to the subspecies of *Ostrea ameghinoi rocana* Von Ihering, illustrated by Weaver, 1931 (in synonymy) but differs by the less convex beak.

GASTROPODA

Class Gastropoda Cuvier, 1797
Subclass Prosobranchia,
Milne-Edwards, 1848
Order Mesogastropoda Thiele, 1925
Superfamily Cerithioidea Férussac, 1819
Family Cerathiidae Férussac, 1899
Genus *Cerithium* Bruguière, 1789

Type species: *Cerithium adansonii* Bruguière, 1792

Diagnosis: Shell conical and robust. The whorls are nearly twice as wide as high, and slightly convex. Ornamentation composed of ribs, spiral growth lines and grain. The aperture broad.

Occurrence: Cretaceous – Recent. World-wide.

Discussion: Type species was established by subsequent designation (Melville, ICZN Opinion 1109).

Cerithium cf. *heeri* Pictet e Renevier, 1854 (Fig. 5: 7)

1931. *Cerithium* cf. *heeri* Pictet e Renevier; Weaver, p. 385, pl. 42, fig. 284

Specimen examined: 45/MNHCu-P3620.

Description: Shell incomplete, medium size (high about 28 mm) conical, high spired and robust. Spiral angle about 35°. The whorls nearly twice as wide as high, and plane to very slightly convex. Ornamentation composed of spiral growth lines and robust grain. The aperture rather broad.

Occurrence: Cretaceous – Recent. World-wide.

Discussion: According to the shape of the shell, ornamentation and dimensions, these specimens are similar to *Cerithium* cf. *heeri* Pictet e Renevier; illustrated in the paper cited in the synonymy. The species *Cerithium heeri* Pictet et Renevier was described from Aptian of France.

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