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APTIAN CEPHALOPODS FROM GABAL ABU RUQUM, NORTH SINAI, EGYPT

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ABSTRACT

Seventeen ammonite species have been collected and identified from Gabal Abu Ruqum, north Sinai, Egypt. The described fauna include representatives of the superfamilies Phylloceratacеae, Tetragonitaceae, Haploceratacеae, Desmoceratacеae, Ancyloceratacae, Douvillieceratacеae and Deshayesitaceae. Along with the ammonites, three belemnite species are recorded: *Neohibolites aptiensis* (Stolley), *Mesohibolites* sp. and *Duvalia* cf. *grasiana* (Duval-Jouve). The nautiloid *Heminautilus lallierianus* (d'Orbigny) is also described. The southern Tethyan affinity of the cepalopod faunas of Gabal Abu Ruqum, as well as El Maghara area, are evident in the composition of the analyzed assemblages. The identified ammonites show a positive comparison with the Aptian fauna of Madagascar, England, Tunisia, Morocco, Algeria, southern England and France. The *Deshayesites deshayesi* Zone (Lower Aptian) could be recognized by the presence of the zonal index species associated with the *Pseudohaploceras matheroni* (d'Orbigny). The beds with *Aconeceras(A.) nisus* (d'Orbigny) represent the basal part of the Upper Aptian, followed by beds with *Cheloniceras dible* Casey and the coarsely ribbed *Hypacanthoplites jacobi* (Collet) respectively.

Key Words: ammonites, nautiloids, belemnites, systematic paleontology, paleobiogeography.

INTRODUCTION

The marine Aptian outcrops of El Maghara area are well known extending in north Sinai, Egypt. They yield a rich macrofaunal assemblages of which ammonites are of particular interest. Although the investigation of the Aptian deposits and fauna from north Sinai have a long history, a few important works concerned with the Aptian cephalopods have appeared in the 20 th century (e.g. Douvillé 1916; Mahmoud 1956; Aly 1988 and 1993; Aboul ela et al. 1991; Gabir 1996). Recently, Hamama (1993), Aly and Abdel-Gawad (2001) and Hamama and Gabir (2001) restudied several Lower Cetaceous sections from El Maghara area, leading to well definition of the Barremian/Aptian and the Aptian/Albian boundaries, as well as the Aptian and Albian substages.

Gabal Abu Ruqum is located to the northeast of Gabal Maghara anticline, between Latitudes 30° 46` and 30° 48` N and Longitudes 33° 25` and 33° 29` E (Fig.1). New stratigraphical ammonite, belemnite and nautiloid distribution data are here presented based on bed-by-bed fauna collected from the Aptian section of Gabal Abu Ruqum, north Sinai, Egypt. The Lower Cretaceous sediments of Gebel Abu Ruqum are mainly consist 85 m thick of fossiliferous marls and limestones intercalated with sand, sandstones and claystones, belonging stratigraphically to the Risan Aneiza Formation, attaining a thickness of 85 m (Fig.2). Depending on well dated ammonite fauna, the studied secction is assigned herein an Aptian age. This work focuses on the systematic study of the collected cephalopod faunas, their stratigraphical distribution, and their paleogeographic affinities.

BIOSTRATIGRAPHY

In temperate and Tethyan realms, ammonites constitute the principal basis for Lower Cretaceous biostratigraphy. The Aptian stage is best zoned by ammonites. In the Tethyan Realm, the ammonite families Douvilleiceratidae, Oppeliidae, Deshayesitidae and to a lesser extent, the Ancyloceratidae and Hoplitidae form the

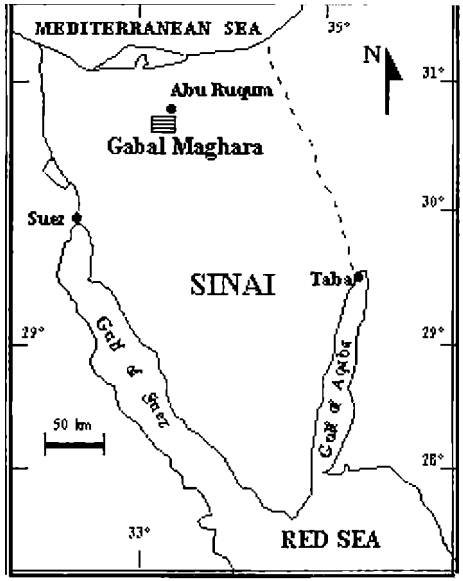


Fig. 1: Location map of Gabal Abu Ruqum.

major basis for zonation and regional correlation (Kauffman 1979). The belemnite groups Belemnopseidae and Duvalidae are of secondary importance.

The present writer followed the English and German custom in subdividing the Aptian into Lower and Upper (e.g. Kemper 1975; Moullade et al. 1980; Rawson 1983; Erba 1996; Mutterlose et al. 2003). A three-fold division into Bedoulian, Gargasian and Clansayesian Substages is common in France (Kilian 1988) and is followed by some workers in Russia (e.g. Baraboshkin 1998; Baraboshkin and Mikhailova 2002). The following ammonite zones are described from Gabal Abu Ruqum:

***P. matheroni- D. deshayesi* Partial Range Zone (Lower Aptian)**

In Gabal Abu Ruqum, the base of this zone is defined by the FO of *Pseudohaploceras matheroni* (d'Orbigny) and *Dshasyesites deshayesi* (d'Orbigny). This zone is represented by about 27 m of highly ferruginated sandstones, dolomitic in its middle parts and grades into highly fossiliferous limestone in its uppermost part (Fig. 2). The zone is characterized by a very rich association: the nautiloid *Heminautilus lallierianus* (d'Orbigny), the ammonites *Hypohylloceras (Hypohylloceras) semistriatum* d'Orbigny, *Subsaynell sayni* (Paquier), *Macroscaphites* cf. *striatisulcatus* (d'Orbigny), *Crioceratites* (*Crioceratites) hammatoptychum* (Uhlig), *Ancyloceras mantelli* Casey, *Dufernoyia* aff. *furcata* (Sowerby) and the belemnite *Duvalia* cf. *grasiana* (Duval-Jouve).

The *matheroni-deshayes* Zone of Gabal Abu Ruqum is equivalent to the *deshayesi* Zone of Gabal Risan Aneiza, north Sinai defined by Hamama and Gabir (2001) and to the *matheroni* Zone of Aly and Abdel Gawad (2001) of Gabal Lagama, north Sinai. The *matheroni-deshayesi* Zone of north Sinai could be correlated with the *deshayesi* Zone of Tunisia, south-east France, southern England, north Germany, Iran and Russia (Table 1).

***Aconeceras nisus* Interval Zone (Upper Aptian)**

This zone attains 15 m thick of yellowish white limestones and marly l toped by thick beds of cross-bedded sandstones (Fig. 2). The *n* comprises the interval between the FO of *Aconeceras nisus* (d'Orbigny) of *Cheloniceras (Epicheloniceras) debile* Casey. The belemnites *Mesohit* along with the ammonites *Hypophylloceras (Hypophylloceras) ser Juberticeras* sp. and *Valdedorsella getulina* (Coquand), are present throu zone.

Aconeceras (A.) nisus (d'Orbigny) has already been used as zonal inc basal zone of the Middle Aptian of south-east France (Sonary 1957) recognized in England in the *Cheloniceras (Epicheloniceras) martino* (Casey 1960-1980). The "Gargasian" was proposed by Kilian (1988) for *Aconeceras nisus* near Gargas south-east France, and marks the Midc Baraboshkin (1998) recognized the *Aconeceras nisus* Zone as a single zone for the Middle Aptian of the Russian Platform, and concluded equivalent to the English *martinoides* and *nutfeildensis* ammonite zones (1961).

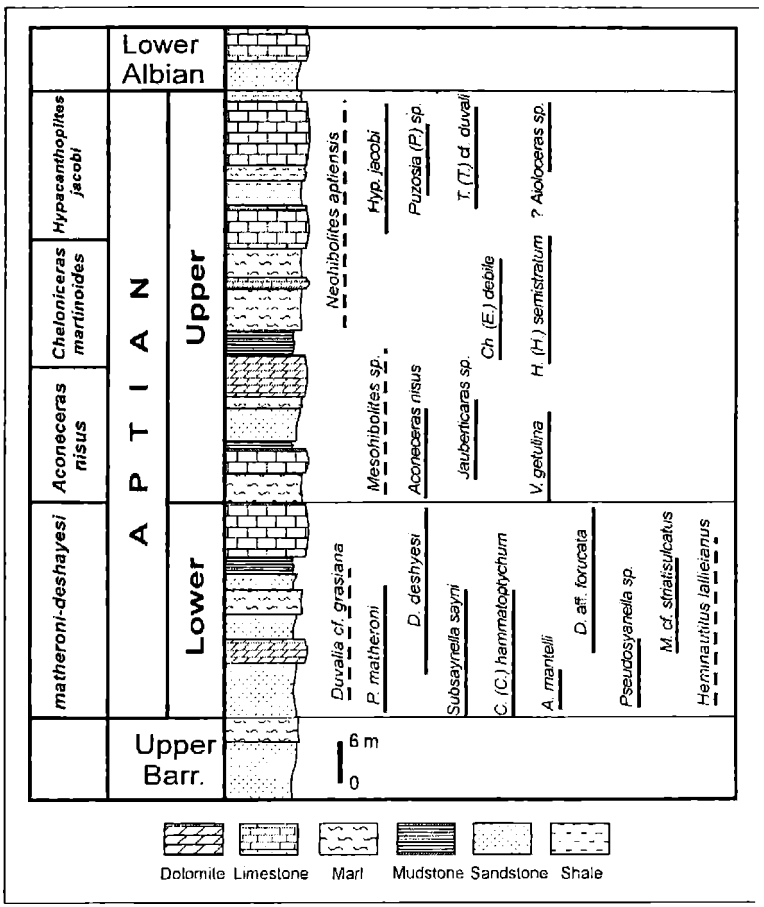


Fig. 2: Stratigraphic columnar section of the Aptian sequence, Gabal Abu Ruqum,

Table 1: Correlation of the French, English and German Aptian ammonite zonal scheme with the Aptian ammonite zones of Egypt.

STAGE		SOUTH-EAST FRANCE (Sonary 1957)	SOUTHERN ENGLAND (Rawson 1983)	NORTH GERMANY (Rawson 1983)	EGYPT: GABAL LAGAMA (Aly & Abdel Gawad 2001)	EGYPT: RISAN ANEIZA (Hamam & Gabir 2001)	EGYPT: GABAL ABU RUQUM Present Study
APTIAN	UPPER	*Diadochoceras nodosocostatum*	*Hypacanthoplites jacobi*	*Hypacanthoplites jacobi*	*Hypacanthoplites jacobi*	*Acanthohoplites uhligi*	*Hypacanthoplites jacobi*
				Acanthohoplites nolani	*Acanthohoplites nolani*		
		Cheloniceras Subnodosocostatum	*Parahoplites nutfieldensis*	*Parahoplites nutfieldensis*	*Chloniceras martinoides*	*Epicheloniceras debile-Clombiceras cf. subpletoceroides*	*Chloniceras martinoides*
		Aconeceras nisus	*Epicheloniceras martinoides*	*Epicheloniceras tschernyschewi*			
				Tropaeum drewi			*Aconeceras nisus*
	LOWER	*Deshayesites deshayesi*	*Tropaeum bowerbanki*	*Tropaeum bowerbanki*	*Pseudohaploceras matheroni*	*Deshayesites deshayesi*	*Pseudohaploceras matheroni-Deshayesites deshayesi*
			Deshayesites deshayesi	*Deshayesites deshayesi*			
			Deshayesites forbesi				
			Prodeshayesites fissicostaus	*Prodeshayesites tenuicostatus*			

In north Sinai, *Aconeceras nisus* Zone was previously designated incorrectly by the present author (Aly 1993) to define the uppermost part of the Upper Aptian of Gabal Lagama, north Sinai. In the present work, the *Aconeceras (A.) nisus* (d'Orbigny) was collected from the limonitic marly beds directly overlying beds with the LO of *Deshayesites deshayesi* (d'Orbigny. On the other hand, it is identified from the beds below the FO of *Cheloniceras (Epicheloniceras) debile* Casey. In conclusion, the occurrence of *Aconeceras nisus* (d'Orbigny) defines the basal part of the Upper Aptian in Gabal Abu Ruqum. It can be correlated with *nisus* Zone of Madagascar (Besairie and Collignon 1972), Tethyan Realm (van Hinte 1976), France (Anonymous 1965; Kilian 1988) and Russia (Baraboshkin 1998).

***Cheloniceras (Epicheloniceras) martinoides* Total Range Zone (Upper Aptian)**

This zone is represented by 24 m thick of a carbonate dominated sequence of limestones and marly limestones intercalated by highly fossiliferous mudstones (Fig. 2). The base of this zone is placed on the FO of *Cheloniceras (Epicheloniceras) debile* Casey. *Hypophylloceras (H.) semistriatum* (d'Orbigny) was collected from the same beds containing *Cheloniceras (E.) debile*. The FO of the *Ch. (E.) debile* is recorded before the LO of *Aconeceras nisus* (d'Orbigny).

Casey (1961) proposed that the *Cheloniceras (Epicheloniceras) martinoides* Zone defines the lower part of the Upper Aptian in the British Lower Greensand. It is subdivded upwards into three subzones: *Ch. (E.) debile, Ch. (E.) gracile* and *Ch. (E.) buxtorfi* subzones. The Russians (e.g. Sazonova, 1958; Glazunova, 1973) have used *Cheloniceras (Epicheloniceras) tshernyschewi*, *Ch. (E.) subnodosocostatum* and *Gargasiceras gargasense* as guide fossil for this part of the succession.

Hamama and Gabir (2001) suggest the *Epicheloniceras debile-Colombiceras cf. supletoceroides* Zone to represent the Middle Aptian (Gargasian) of Gabal Risan Aneiza, north Sinai, and concluded that it is equivalent to the *crassicostatum-subnodosocostatum* Zone of the Mediterranean Province. In addition, Aly and Abdel Gawad (2001, p. 38, pi. 2, fig. 12) described a single fragment from Gabal Lagama and attributed it to *Cheloniceras (Epicheloniceras) martinoides* Casey. They also identified *Cheloniceras (E.) tschernyschewi* (Sinzow) and *Procheloniceras pachplura* (Douvillé) from the same horizon.

In Gabal Abu Ruqum, the occurrence of *Cheloniceras (E.) debile* overlying the beds with *Aconeceras (A.) nisus,* should define the basal part of the Upper Aptian *martinoides* Zone. This 24 m thick interval with *Ch. (E.) debile,* is easily correlatable with the *martinoides* Zone of Aly and Abdel Gawad (2001), and *Epicheloniceras debile-Colombiceras cf. supletoceroides* Zone of Hamama and Gabir (2001). It is partly equivalent to the *martinoides* Zone of England, especially the *debile* Subzone; to the *tscheryschewi* Zone of Russia (Glazunova 1973) and North Germany (Rawson 1983).

***Hypacanthoplites jacobi* Total Range Zone(Upper Aptian)**

It is composed of 19 m thick of vary colored shales at its lower part and grades upward into marly to marly limestones with abundant rudist fragments (Fig. 2). The base of this zone placed at the FO of the strongly ribbed *Hypacanthoplites jacobi* (Collet). *Puzosia (P.)* sp., *Tetragonites (Tetragonites)* cf. *duvali* d'Orbigny and ?*Aioloceras* sp., along with the belemnite *Neohibolites aptiensis* (Stolley) are collected from this zone.

In south-east France, Breistroffer (1947) placed the Upper Aptian

Diadochoceras nodosocostatum Zone to follow the Middle Aptian *Aconeceras nisus* Zone. In southern England, Casey (1961) proposed the *Parahoplites nutfieldensis* and *Hypacanthoplites jacobi* overlying the *Epicheliniceras martinoides* Zone. He included three subzones within the *Hypacanthoplites jacobi* Zone: *Nolaniceras nolani, Hypacanthoplites rubricosus* and *Hypacanthoplites anglicus* in ascending order. Casey (1999) relegated the *Nolaniceras nolani* Subzone to the uppermost Aptian and drew the Aptian/Albian boundary at the base of the *Hypacanthoplites rubricosus* Zone. Owen (1992) proposed to return to the *Diadochoceras nodosocostatum* Zone, with a lower Subzone of *Nolaniceras nolani* and an upper Subzone of *Hypacanthoplites jacobi.*

Aly and Abdel Gawad (2001) identified *Nolaniceras nolani* Seuens and *Hypacanthoplites paucicostatus* Breistroffer from Gabal Lagama, north Sinai; and placed the *nolani* and *jacobi* zones overlying the Upper Aptian *martinoides* Zone. The *Acanthohoplites uhligi* Zone was proposed by Hamama and Gabir (2001) to define the uppermost Aptian in Gabal Risan Aneiza and to be an equivalent to the Mediterranean "*Acanthohoplites" nolani* Zone.

In the present study, the zone of *Parahoplites nutfieldensis* or allied species is not recorded. Also, the genus *Diadochoceras* has not been recorded here. The occurrence of a complete single specimen and two crushed internal molds of *Hypacanthoplites jacobi* (Collet) overlying the LO of *Cheloniceras (Epicheloniceras) debile* Casey support the definition of *jacobi* Zone in Gabal Abu Ruqum. The subdivision into formal subzones is not applicable due to the absence of the zonal index species. However, the *jacobi* Zone of Gabal Abu Ruqum is equivalent to the same Zone of Aly and Abdel Gawad (2001), partly equivalent to the *uhligi* Zone of Hamama and Gabir (2001). The presence of the key species in the studied section, makes the correlation with the *jacobi* Zone of North Germany, Russia and the Lower Greensand of England more possible.

BASE OF THE APTIAN STAGE IN NORTH SINAI

It is generally agreed that the appearance of the earliest deshayesitid ammonite, *Prodeshayesites* marks the base of the European Aptian in England and North Germany (Birkelund et al. 1984; Hancock 1991; Erba 1996). In SE France and most of the Tethyan regions the base of the Aptian has been drawn at the base of *Deshayesites deshayesi* Zone (Delanoy, 1995). Busandro (1965) placed the base of the Aptian Stage at the first appearance of *Pseudohaploceras matheroni* (d'Orbigny). Erba (1996) mentioned that this species is now known to appear in the latest Barremian. The Cephalopod working group of IGCP Project 262 adopted the Georgian Aptian ammonite sequence as a 'standard' for the Mediterranean Region (Hoedmaeker and Bulot 1990). In this section the base of the Aptian Stage is marked at the base of *Deshayesites tuarkyricus* Zone, where *Prodeshayesites* is not recorded.

During the Early Cretaceous, two separate realms can be distinguished, based on the belemnite assemblages (Mutterlose 1990). The Tethys was characterized by Duviliidae and Belemnopseidae, wheres the Boreal Realm was distinguished by the Cylindroteuthididae. In NW Europe, *Neohibolites ewaldi,* the marker of the *ewaldi* zone, is firstly recorded in the *Deshayesites deshayesi* ammonite zone of the Lower Aptian. It ranges upwards into the lower part of the Upper Aptian (*Tropaeum drewi* ammonite zone), where it is replaced by *N. clava.* The base of the *clava* zone is defined by the change from *N. ewaldi* to *N. clava,* wheres its top is defined by the change from *N. clava* to *N. inflexus.* The *clava* zone covers the lower part of the

Upper Aptian, the upper part of the *Tropaeum drewi,* and the *Epicheloniceras tschernyschewi* ammonite zones. The subsequent *N. inflexus* zone, is characterized by *N. inflexus (inflexus-Marl) of* the middle Upper Aptian *(Porahoplites nutfieldiensis* ammonite zone). The *N. wollemanni* zone, which is of late Late Aptian age *(Acanthoplites nolani* & *Hypacanthoplites jacobi* ammonite zones), yields *N. wollemanni* which is replaced by *Neohibolites strombecki* Stolley at the Aptian/Albian boundary (Table 1).

In recent findings from northwestern Germany, Mutterlose (1998) recorded the belemnite *Duvalia grasiana* to co-occurr with *Neohibolites ewaldi. Duvalia*, a strictly Tethyan genus, ranges from the Tithonian to the Aptian in the Tethyan Realm (Combemorel 1973). Mutterlose (1987) recorded *D.* grasiana from the middle Early Aptian of northwestern Germany associated with *Neohibolites inflexus.* In addition, Stolley (1911) describes rare specimens of *D.* grasiana from the earliest Aptian of northwestern Germany. Thus, Mutterlose (1998) concluded that it is possible to identify two separate horizons of *Duvalia* event, a mid-Early Aptian and a mid-Late Aptian *Duvalia* events (see Fig. 3).

In north Sinai, Aly and Abdel Gawad (2001) placed the Barremian/Aptian boundary at the LO of the Upper Barremian *Costidiscus recticostatus* (d'Orbigny) and the FO of the Lower Aptian *Pseudohaploceras matheroni* (d'Orbigny). Hamama and Gabir (2001) concluded that the contact between the Barremian and Aptian is tentatively placed within the barren interval underlying a bed with typical Lower Aptian ammonites of *Deshayesites deshayesi* (d'Orbigny) and *Cheloniceras seminodosum* (Sinzow).

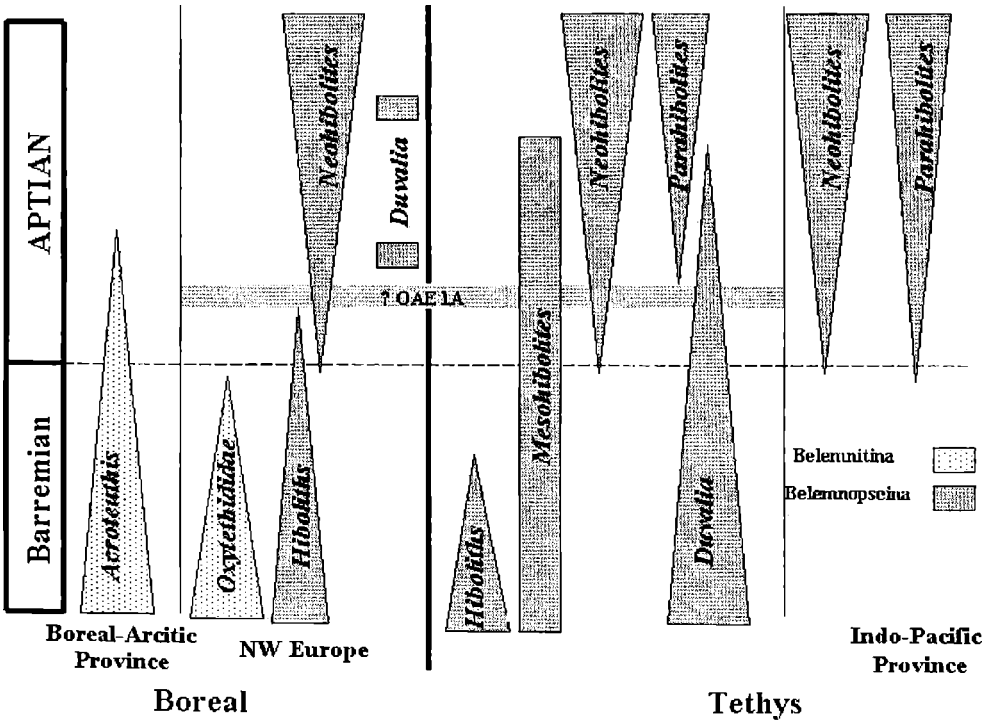


Fig. 3: Global range of various belemnite taxa from the Barremian-Aptian boundary (after Mutterlose 1998).

The present author agrees with the conclusions of Aly and Abdel Gawad (2001; Fig. 2) to defining the base of the Aptian Stage in north Sinai at the LO of *Costidiscus recticostatus* (d'Orbigny). Coquand, who first proposed recognition of the Barremian Stage, regarded the Mediterranean ammonite species C. *recticostatus* as one of its characteristic fossils, and marks the uppermost part of the Barremian Stage (Coquand, 1862).

However, *Prodeshayesites* is neither recorded from Gabal Abu Ruqum nor described previously from the Aptian of north Sinai. The co-occurrence of *Deshayesites deshayesi* (d'Orbigny) and *Pseudohaploceras matheroni* (d'Orbigny) defines the base of the Aptian at Gabal Abu Ruqum. The presence of three specimens of *Pseudosaynella* sp. is quite remarkable. In addition, the occurrence of the belemnite *Duvalia* cf. *grasiana* (duval-Jouve) in beds containing *D. deshayesi* and *P. matheroni* supports the lower *Duvalia* event of Mutterlose (1998), and marks the Lower Aptian in Gabal Abu Ruqum section.

SYSTEMATIC PALAEONTOLOGY

Material: The present work is focused on the Aptian cephalopods of Gebel Abu Ruqum, north Sinai. This material consists of 16 belemnite guards, five nautiloid internal molds and 194 complete and incomplete ammonite specimens. The belemnites were carefully separated from the associated pelecypods and gastropods embedded in calcareous silty sandstone beds. They are mostly crushed, incomplete guards that lack the alveolar regions. Nautiloids are represented by complete specimens, mostly showing well preserved suture lines and subcentral siphuncles. The ammonites occur in abundance in random orientation through the clastic-dominated succession. Ammonites are mostly represented by middle-aged and mature specimens. They are almost complete internal molds and the suture lines are only illustrated in the well preserved specimens.

Depositary: All the collected specimens are housed at the Palaeontological Museum of the Geology Department, Cairo University, and are stored with the collection number ARB/01/CUGM-ARB/16/CUGM for belemnites, ARN/01/CUGM-ARN/05/CUGM for nautiloids, and ARA/01/CUGM-ARA/194/CUGM for ammonites.

Abbreviations used: ARB = Abu Ruqum belemnites. ARN = Abu Ruqum nautiloids. ARM = Abu Ruqum ammonites. CUGM = Cairo University, Geologic Museum.

1. BELEMNITES:

During the earliest Cretaceous (Berriasian-Barremian) the belemnite faunas are characterized by a distinctive provincialism on a global scale. The Tethyan Realm is marked by the suborder Belemnospeina (Mutterlose 1998). The belemnite faunas of the Boreal Realm on the other hand, consist of representatives of the suborder Belemnitina. In Aptian times, this clear provincialism vanished; Tethyan and Boreal taxa were replaced by cosmopolitan ones, in particular by genus *Neohibolites* (see Fig. 3). From the Aptian to the early Late Cretaceous *Neohibolites* is the most common belemnite genus both in the Tethys and the Boreal realms (Stevens 1973; Mutterlose 1988, 1998). In the Barremian the belemnite faunas of the Mediterranean area are characterized by genera included in the suborder Belemnospeina: *Hibbolites, Mesohibolits* and *Duvaila* (Combemorel 1973). *Mesohibolits* and *Duvaila* survived the Barremian-Aptian boundary, and in the early Aptian they were replaced by *Neohibolites* and to a lesser extent *Parahibolites* (Fig.

3).

Jeletzky (1966) was the first to attempt a modern revision of the subclass Coleoidea, which he subdivided into six orders. Among them, the order Belemnitida was subdivided into three suborders: Belemnitina, characterized by forms with one or more apical grooves; Belemnopseina, with forms possessing alveolar grooves; Diplobelina, including taxa characterized by a reduced rostrum. Engeser and Bandel (1988) proposed a new classification of the subclass Coleoidea, based on phylogenetic systematics, distinguishing two evolutionary lines: the extinct monophylum Belemnoidea, and the Vampyromorphoidea and Decapoda, both characterized by fossil and living forms. In their classification scheme the Coleoidea are represented by the following superorders: Belemnoidea, Vampyromorphoidea and Decapoda. Belemnoidea is subdivided into four orders: Aulacocerida, Phragmoteuthida, Belemnitida and Diplobelida.

Three belemnite species are identified in the present study. *Neohibolites aptiensis* (Stolley), *Mesohibolites* sp. and the Duvalia cf. *grasiana* (Duval-Jouve) are representatives of the suborder Belemnospeina.

Measurements: L, total preserved length; l, length of the post alveolar portion; Dv, dorso-ventral diameter at the alveolar opening; Dl, lateral diameter at the alveolar opening; Dvmax, maximum dorso-ventral diameter; Dlmax, maxi-mum lateral diameter; X, length from apex to Dmax (Fig. 4: 1).

For descriptive and reference use more than 16 collected specimens, either complete or fragmentary, were considered. Some specimens were photographed and subsequently polished to examine transverse and longitudinal sections.

Class Cephalopoda Cuvier, 1797
Subclass Coleoidae Bather, 1888
Superorder Belemnoida Gray, 1849
Order Belemnitida Gray, 1849
Suborder Belemnospeina Jeletzky, 1965
Family Belemnopseidae Naef, 1922
Genus *Neohibolites* Stolley, 1911
Neohibolites aptiensis (Stolley, 1911)
(Pl. 1, Figs. 1-4)

1913 *Neohibolites aptiensis* (Stolley); Kilian, p. 324.

1916 *Pseudobelus aptiensis* Stolley; Douvillé, p. 89, pl. XVII, fig. 1.

1991 *Neohibolites* sp.; Aboul Ela *et al.*, pl. 9, figs. 1, 2.

1993 *Neohibolites aptiensis* (Stolley); Aly, pl. 20, figs. 6, 7.

Material: Five incomplete adult rostra, partially eroded and lacking the alveolar region; three fragments of the alveolar region; *martinoides* and *jacobi* zones, ARB/01/CUGM- ARB/08/CUGM.

Measurements: (in mm):

Specimen	L	DV	Dl	DVmax	Dlmax
ARB/01/CUGM	53	-	-	11	17
ARB/02/CUGM	51	-	-	8	15
ARB/03/CUGM	49	-	-	7	13
ARB/04/CUGM	44	-	-	6	12
ARB/05/CUGM	42	-	-	6	11

Description: The rostrum is medium-sized and slender. The profile is symmetrical and hastate. The outline is symmetrical and hastate with its maximum diameter (Dvmax) about one third of the length from the apex. The lateral sides converge towards the point of minimum inflation. The transverse section is circular. Weak lateral lines are present on the flanks.

Distribution: Neohibolites aptiensis is a worldwide Aptian species. It is recorded in Egypt from the Upper Aptian of north Sinai (Gabal Manzour, Gabal Lagama and Gabal Abu Ruqum; Aboul Ela et al. 1991; Aly 1993).

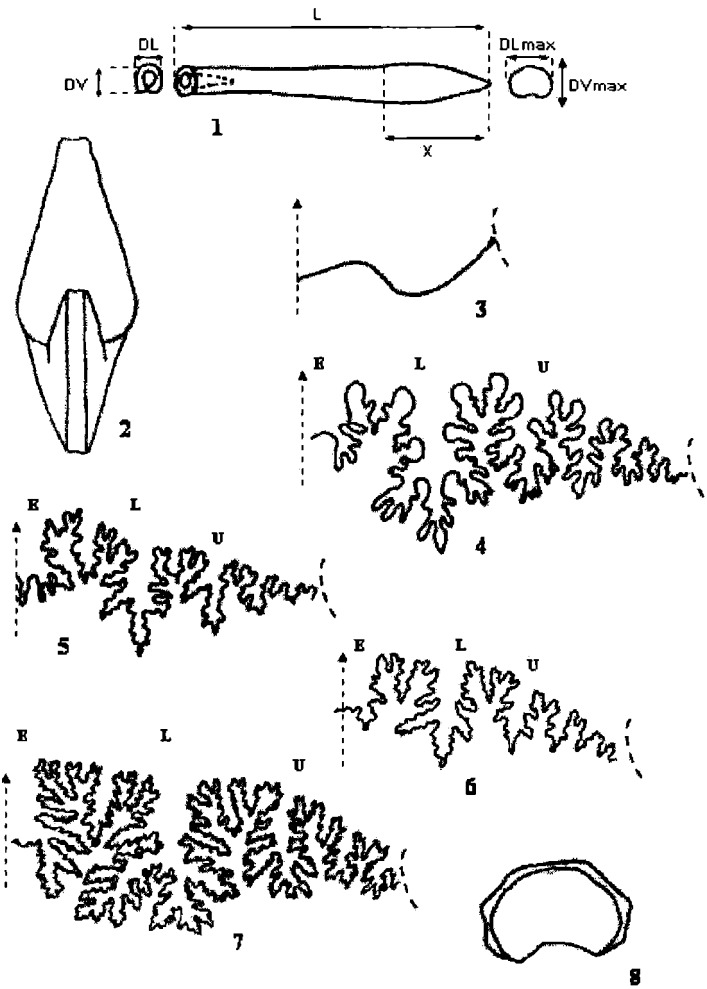


Fig. 4: 1) Principle measure of the belemnite rostrum (After Mariotti, 2003); 2) Diagrammatic whorl section of Heminautilus lallierianus (d'Orbigny), Wh = 70 mm; 3) Suture line of *Heminautilus lallierianus* (d'Orbigny), Wh = 70 mm; 4) Suture line of *Hypophylloceras* (*Hypophylloceras*) *semistriatum* (d'Orbigny), Wh = 117 mm; 5) Suture line of ?*Aioloceras* sp., Wh = 99 mm; 6) Suture line of *Pseudohaploceras matheroni* (d'Orbigny), Wh = 136 mm, 7) Suture line of *Puzosia* (*Puzosia*) sp., Wh = 54 mm; 8) Diagrammatic whorl section of *Cheloniceras* (*Epicheloniceras*) *debile* Casey, Wh = 61 mm.

Genus *Mesohibolites* Stolley, 1911
Mesohibolites sp.
(Pl. 1, Figs. 5-7)

Material: Three almost complete rostra of adult specimens; two fragments of the apical region, *nisus* Zone, ARB/09/CUGM- ARB/13/CUGM.

Measurements: (in mm):

Specimen	L	DV	Dl	DVmax	Dlmax
ARB/09/CUGM	47	5	6	8	9
ARB/10/CUGM	42	4	6	8	8
ARB/11/CUGM	38	3	5	6	7

Description: Middle-sized, depressed rostrum. Outline symmetrical and hastate, profile asymmetrical and hastate. Prominent and broad ventral alveolar groove, ending near the apex. Depressed cross section in the stem and apical regions. narrow and long.

Family Duvaliidae Pavlow, 1914
Genus *Duvalia* Bayle, 1878
Duvalia cf. *grasiana* (Duval-Jouve, 1841)
(Pl. 1, Figs. 8a-b)

1916 *Duvalia* cf. *grasi* Duval-Jouve; Douvillé, p. 90.

1973 *Duvalia grasiana* (Duval-Jouve); Stevens, pl. 1, figs. D, E, F.

Material: Three rostra lacking the alveolar region and a portion of the stem, matheroni-deshayesi Zone, ARB/14/CUGM- ARB/16/CUGM.

Measurements: (in mm):

Specimen	L	DV	Dl	DVmax	Dlmax
ARB/14/CUGM	58	-	-	21	27
ARB/15/CUGM	55	-	-	19	25
ARB/16/CUGM	51	-	-	17	24

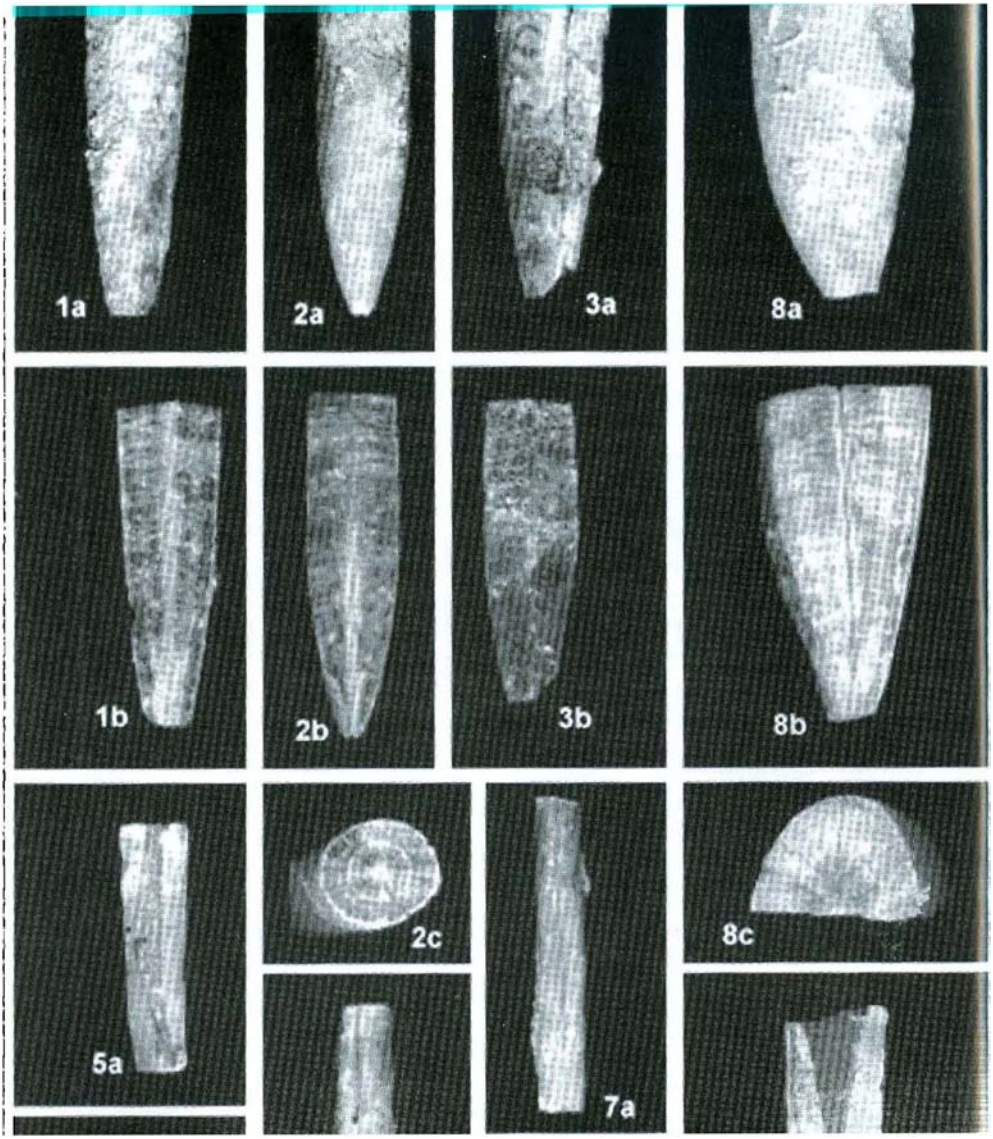
Description: Medium-sized, relatively compressed rostrum. The outline is symmetrical and hastate, with the maximum lateral diameter (Dlmax) corresponding to the mid-point. Profile hastate and symmetrical to very slightly asymmetrical. The transverse section is subrectangular with the ventral side slightly more developed. Apex acute.

Remarks: The studied rostra resemble the figured specimens in Stevens (1973), but the non-preservation of the alveolar region makes the complete identification difficult.

Distribution: It is identified from the Lower Aptian of Gabal Abu Ruqum, France and Bulgaria.

2. NAUTILOIDS:

One species is recorded from the study area. The collected specimens ranges from adult to juvenile nautiloids. The history of the discovery of the Lower Cretaceous nautiloids from north Sinai was dated to 1916 by Douvillé who recorded *Heminautilus lallierianus* (d'Orbigny) from Gabal Lagama. Recently, Aly (1993) identified *Heminautilus lallierianus* (d'Orbigny) and *Cymatoceras sakalavum* (Collignon) from Gabal Lagama.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1841 *Nautilus Lallierianus* D' Orbigny, p. 318.

1858 *Nautilus Lallierianus* D' Orbigny; Pictet and Campiche, p.148, pl. 19, fig. 6.

1916 *Nautilus lallieri* d' Orbigny; Douvillé, p. 129, pi. XVII, figs. 2-6.

1956 *Heminautilus lallierianus* (d' Orbigny); Kummel, p. 434.

1993 *Heminautilus lallierianus* (d' Orbigny); Aly, pl. 13, figs. 1-3.

Material: Five complete internal molds and seven fragments as parts of the phragmocone, *matheroni-deshayesi* Zone, ARN/01/CUGM- ARN/05/CUGM.

Measurements: (in mm):

Specimen	D	Wb	Wh	Wb/Wh	U
ARN/01/CUGM	70 (100)	26 (37.1)	43 (61.4)	0.60	-
ARN/02/CUGM	55 (100)	24 (43.6)	38 (69.0)	0.63	2 (3.6)
ARN/03/CUGM	45 (100)	21 (46.6)	34 (75.5)	0.62	2 (4. 4)
ARN/04/CUGM	38 (100)	19 (50.0)	32 (71.1)	0.60	-
ARN/05/CUGM	23 (100)	14 (60.8)	17 (73.9)	0.82	-

Description: Involute, compressed, whorls much higher than wide. Flanks flattened, strongly converging toward narrow, flattened to slightly concave venter (Fig. 4: 2). Ventral shoulders angular broadly rounded; umbilical shoulders broadly rounded. Very weak sinuous ribs that curve strongly aborally are characteristic. Suture rather sinuous with ventral lobe, subangular saddle on ventral shoulder, broad deep lateral lobe (Fig. 4: 3). Siphuncle well preserved, subcentral in position lying closer to the rostrum than the venter.

Remarks: Kummel (1956) proposed that *Heminautilus lallierianus* (d'Orbigny) is sufficiently distinct from *Heminautilus saxbii* (Morris) In the form of the septa and ornamentation of the conch.

Distribution: *Heminautilus lallierianus* is a world wide Lower Cretaceous species recorded from Europe (England, France, Switzerland); North America, Asia (Palestine, Japan), South America (Colombia), and Ethiopia. It is recorded from the Lower Aptian of north Sinai (Gabal Abu Ruqum and Gabal Lagama).

3. AMMONITES:

The generic composition of the Aptian ammonite faunas in the Mediterranean is richer compared with the Barremian, though with considerably fewer endemic

Explanation of Plate 1

Fig.

1-4. *Neohibolites aptiensis* (Stolley), 1, ARB/01/CUGM, a) lateral view, b) longitudinal section, X 0.85; 2, ARB/02/CUGM, a) lateral view, b) longitudinal section, c) transverse section; X 1;

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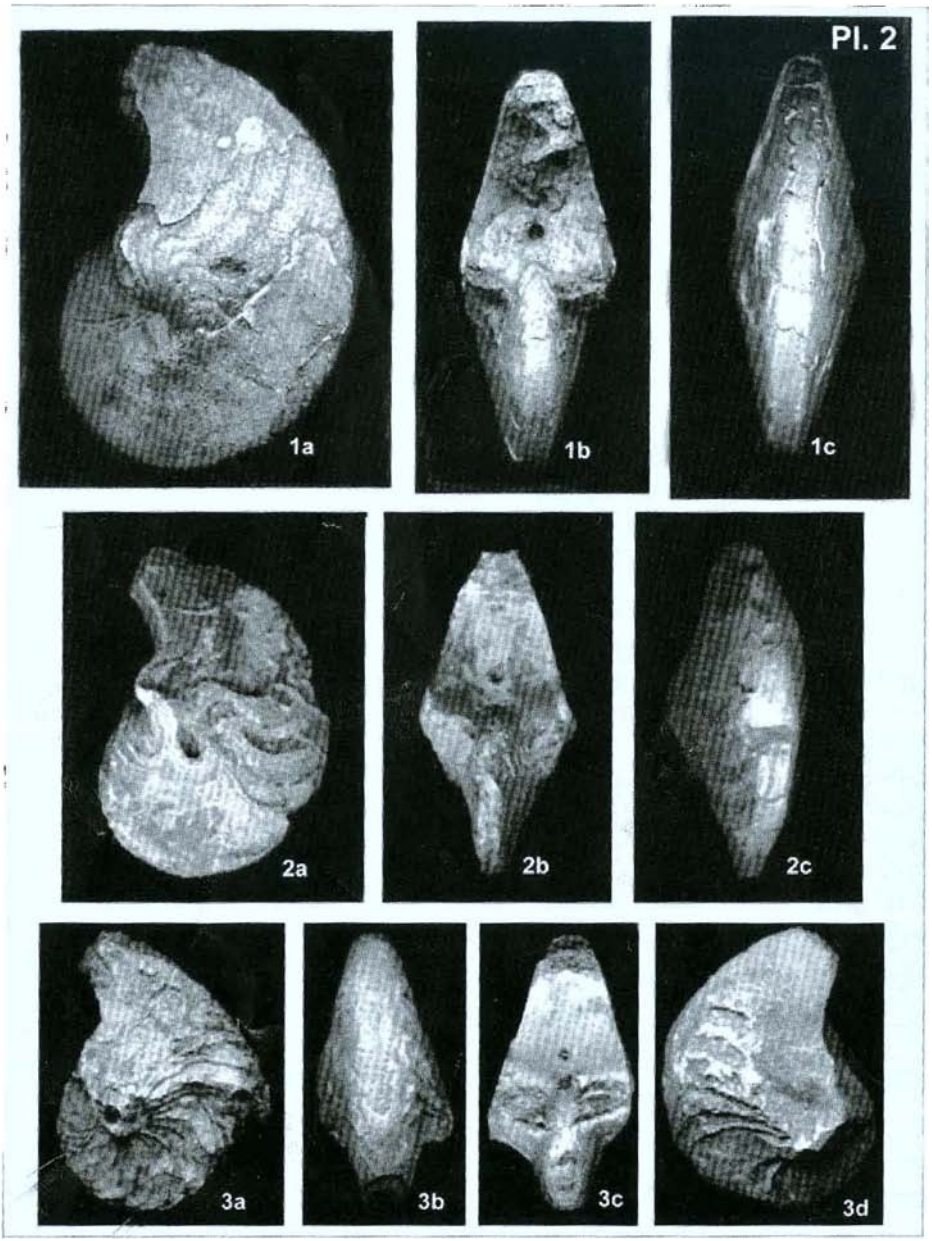

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through the Russian Platform and Caucuses to southern and western Europe. Whears, Tropaeum - a heteromorph genus which occurs more rarely in the Mediterranean Region- moved northwards to the Arctic Canada.

The terminology employed in ammonite description is that of Adkins (1928) and Young (1957). The systematic classification used herein follows Wright (1996).

Dimensions: All dimensions are in millimeters; figures in parentheses are individual measurements as a percentage of diameter. D = diameter of shell; Wb = whorl breadth; Wh = whorl height; U = umbilical diameter from seam to seam.

Suture terminology: The suture terminology of Weidmann and Kullman (1980) is followed in the present work; U = umbilical lobe; E = external lobe; L= lateral lobe.

Subclass Ammonoidea Zittel, 1884
Suborder Phylloceratina Arkell, 1950
Superfamily Phylloceratacеae Zittel, 1884
Family Phylloceratidae Zittel, 1884
Subfamily Phylloceratinae Zittel, 1884
Genus *Hypophylloceras* Salfeld, 1924
Subgenus Hypophylloceras Salfeld, 1924
Hypophylloceras (*Hypophylloceras*) *semistriatum* (d'Orbigny, 1840)
(Pl. 3, Fgs. 1-2)

1840 *Ammonites semistriatus* d'Orbigny, p. 36, pi. 41, figs. 3-4.

1916 *Phylloceras (Phylloceras) semistriatum* d'Orbigny; Douvillé, p. 98, pl. 12, figs. 1-2.

Material: Five complete internal molds; *matheroni-deshayesi* Zone, ARA/01/CUGM-ARA/05/CUGM.

Measurements: (in mm):

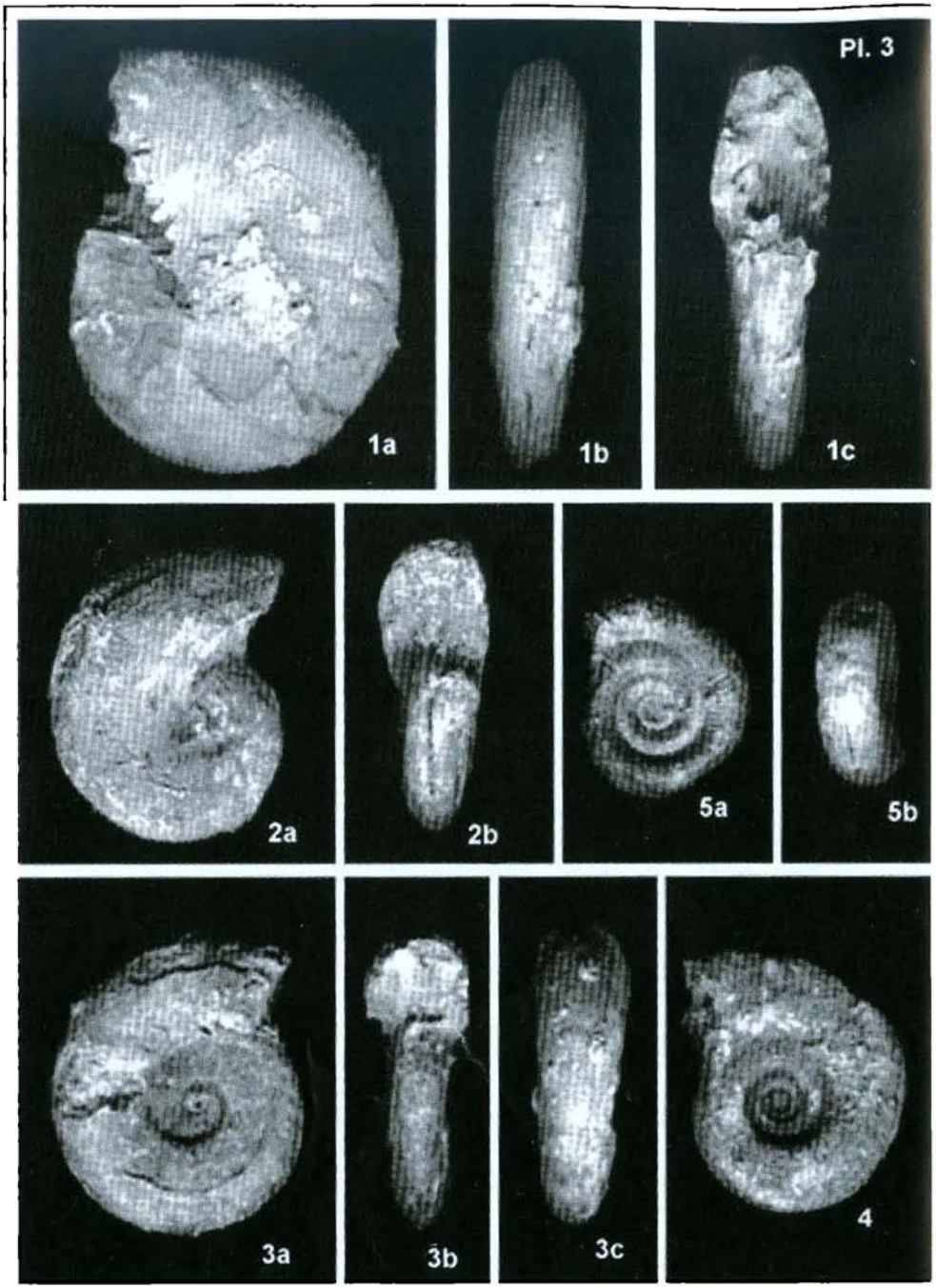
Specimen	D	Wb	Wh	Wb/Wh	U
ARA/01/CUGM	117 (100)	32 (27.3)	58 (49.6)	0.55	-
ARA/02/CUGM	96 (100)	30 (31.2)	55 (57.2)	0.55	8 (8.3)
ARA/03/CUGM	47 (100)	21 (44.6)	26 (55.3)	0.81	5 (10.6)

Description: Much involute, compressed internal molds. Whorl section elliptical, thickest near mid-flank. Sides feebly convex, evenly graded into arched venter. Umbilicus narrow, funnel-like. No constrictions. Suture characterized by simple diphylloid saddles, L/U_2 triphylloid (Fig. 4: 4).

Remarks: The lateral lobe of *Hypophylloceras* (*Hypophylloceras*) *semistriatum* is less asymmetric than on *Phylloceras* (*Hypophylloceras*) *moreti* (Mahmoud 1956). Also, the present species can be differentiated from *Phylloceras* (*Hypophylloceras*) *velledae velledae* (Michelin) by having less pronounced ribbing.

Distribution: Barremian-Aptian of north Sinai, Tunisia, France and Austria.

Suborder Lytoceratina Hyatt, 1889
Superfamily Tetragonitaceae Hyatt, 1900
Family Tetragonitidae Hyatt, 1900
Genus *Tetragonites* Kossmat, 1895
Sungenus *Tetragonites* Kossmat, 1895
Tetragonites (*Tetragonites*) cf. *duvali* d'Orbigny, 1840
(Pl. 3, Figs. 3-4)



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1840 *Ammonites Duvalianus* d'Orbigny, p. 158, pl. 50, figs. 4-6.

1907 *Lytoceras* cf. *Duvalianum* d'Orbigny; Jacob, p. 12, pl. 1, fig. 4.

1916 *Tetragonites* cf. *Duvali* d'Orbigny; Douvillé, p. 95, pl. XI, figs. 8-9.

Material: Eight complete well preserved internal molds, and 23 poorly preserved and crushed and relatively damaged specimens; *jacobi* Zone, ARA/06/CUGM-ARA/36/CUGM.

Measurements: (in mm):

Specimen	D	Wb	Wh	Wb/Wh	U
ARA/06/CUGM	52 (100)	17 (32.7)	21 (40.3)	0.81	18 (34.6)
ARA/07/CUGM	48 (100)	16 (33.3)	19 (39.6)	0.84	14 (29.1)
ARA/08/CUGM	47 (100)	17 (36.2)	19 (40.4)	0.89	15 (31.9)
ARA/09/CUGM	44 (100)	15(34.1)	18 (40.9)	0.83	12 (27.3)
ARA/10/CUGM	40 (100)	13 (32.5)	16 (40.0)	0.81	10 (25.0)
ARA/11/CUGM	39 (100)	12 (30.7)	16 (41.0)	0.75	9 (23.1)
ARA/12/CUGM	37 (100)	11 (29.7)	15 (40.5)	0.73	7 (19.1)
ARA/13/CUGM	33 (100)	9 (27.3)	13 (39.4)	0.69	6 (18.2)

Description: Relatively large *Tetragonites,* moderately evolute. Whorl section subtrapezoidal to rounded in adult specimens. Flanks feebly convex, slightly converging towards flattened, broadly arched venter. Umbilicus deep, more wide in adults, with an average of 26 % of shell diameter. Umbilical wall vertical. Constrictions prosiradiate, projected forward, cross straight over sides. Sutures partly preserved.

Remarks: *Tetragonites (T.) rectangularis* Weidmann (1962, p. 63, pl. 7, figs. 145-148) differs from the present species by its subrectangular and a more wider venter. *Tetragonites (T.) kitchini* Krenkel (1910a, p. 226, pl. 22, fig. 8) has a markedly smaller whorl width and wider umbilicus (about 31 % of diameter).

Distibution: Upper Aptian of Gabal Abu Ruqum, and Lower Albian of Gabal Manzour and Gabal Raghawi, north Sina Egypt; Aptian-Albian of France.

Subfamily Gabbioceratinae Breistroffer, 1953

Genus *Jauberticeras* Jacob, 1907

Jauberticeras sp.

(Pl. 3, Figs. 5a-b)

Material: Two complete internal molds, *nisus* Zone. ARA/37/CUGM-ARA/38/CUGM.

Measurements: (in mm):

Specimen	D	Wb	Wh	Wb/Wh	U
ARA/37/CUGM	23 (100)	9 (39.1)	8 (34.7)	1.13	12 (52.2)
ARA/38/CUGM	21 (100)	8 (38.1)	7 (33.3)	1.14	11 (52.4)

Description: Juvenile specimens of *Jauberticeras*, evolute and cadicone. Whorl breadth as much as whorl height. Whorl section more or less compressed. Venter convex, rounded. Umbilicus 52% of diameter, wide for genus. Umbilical wall moderately steep slope from lateral angle towards umbilical seem. Ornament consists of dense prosiradiate striae. Four distinct constrictions observed on last volution. Suture not observable on the present material.

Suborder Ammonitina Hyatt, 1889
Superfamily Haploceratáceae, Zittel, 1884
Family Oppeliidae Bonarelli, 1894
Subfamily Aconeceratinae Spath, 1923
Genus *Aconeceras* Hyatt, 1903
Subgenus *Aconeceras* Hyatt, 1903
Aconeceras (*Aconeceras*) *nisus* (d'Orbigny, 1841)
(Pl. 4, Figs. 1a-b)

1841 *Ammonites Nisus* d'Orbigny, p. 184, pi. 55, figs. 7-9.

1955 *Aconeceras nisum* d'Orbigny; Eristavi, p. 88.

1961 *Aconeceras* cf. *nisus* (d'Orbigny); Casey, p. 128, text-fig. 40f.

1962 *Aconeceras nisus* (d'Orbigny); Collignon, p. 31, pl. 229, fig. 972.

1979 *Aconeceras nisus* (d'Orbigny); Martinez, p. 346, pl. 1, figs. 6a-c.

1982 *Aconeceras* cf. *nisus* (d'Orbigny); Renz, p. 21, pl. 1, figs. 15a-b; 19a-b; text-fig. 9a (with synonymy).

1998 *Aconeceras nisus* (d'Orbigny); Baraboshkin, p. 1140, pl. 3, fig. 1.

Material: Four complete moderately preserved internal molds and two crushed specimens; *nisus* Zone, ARA/39/CUGM- ARA/44/CUGM

Measurements: (in mm):

Specimen	D	Wb	Wh	Wb/Wh	U
ARA/39/CUGM	24 (100)	8 (33.3)	11 (45.8)	0.72	3 (12.5)
ARA/40/CUGM	19 (100)	7 (36.8)	10 (52.6)	0.70	2 (10.5)
ARA/41/CUGM	15 (100)	6 (40.0)	9 (60.0)	0.66	2 (13.3)
ARA/42/CUGM	15 (100)	5 (33.3)	8 (53.3)	0.62	2 (13.3)

Description: Medium sized *Aconeceras*, involute, oxycone to compressed conch. Sides feebly convex to flat, converging towards low keel without venterolateral shoulder. Umbilical narrow (10-13% of diameter); low steep umbilical wall with narrowly rounded edge. No sculpture observed. Suture indistinctly preserved.

Remarks: The studied specimens are very similar to the specimens figured by Wright and Wright (1950, p. 123) as *Aconeceras (Aconeceras) haugi* (Sarasin), but the absence of the rounded venterolateral shoulder indicates that they belong to *Aconeceras (Aconeceras) nisus* (d'Orbigny).

Distribution: *Aconeceras (A.) nisus* is a worldwide Upper Aptian species and considered as zonal index species in the works of many authors (Besairie and Collignon, 1972; van Hinte, 1976; Baraboshkin, 1998). It is recorded from Europe, Greenland, Algeria, South and East Africa, Madagascar, Australia, Argentina, Venezuela and Nepal.

Superfamily Desmoceratáceae Zittel, 1895
Family Desmoceratidae Zittel, 1895
Superfamily Desmoceratáceae Zittel, 1895
Family Desmoceratidae Zittel, 1895
Subfamily Barremitinae Breskovski, 1977
Genus *Subsaynella* Spath, 1923
Subsaynella sayni (Paquier, 1900)
(Pl. 4, Figs. 2-3)

1900 *Desmoceras sayni* Paquier, p. v, vi, pl. 8, fig. 2.