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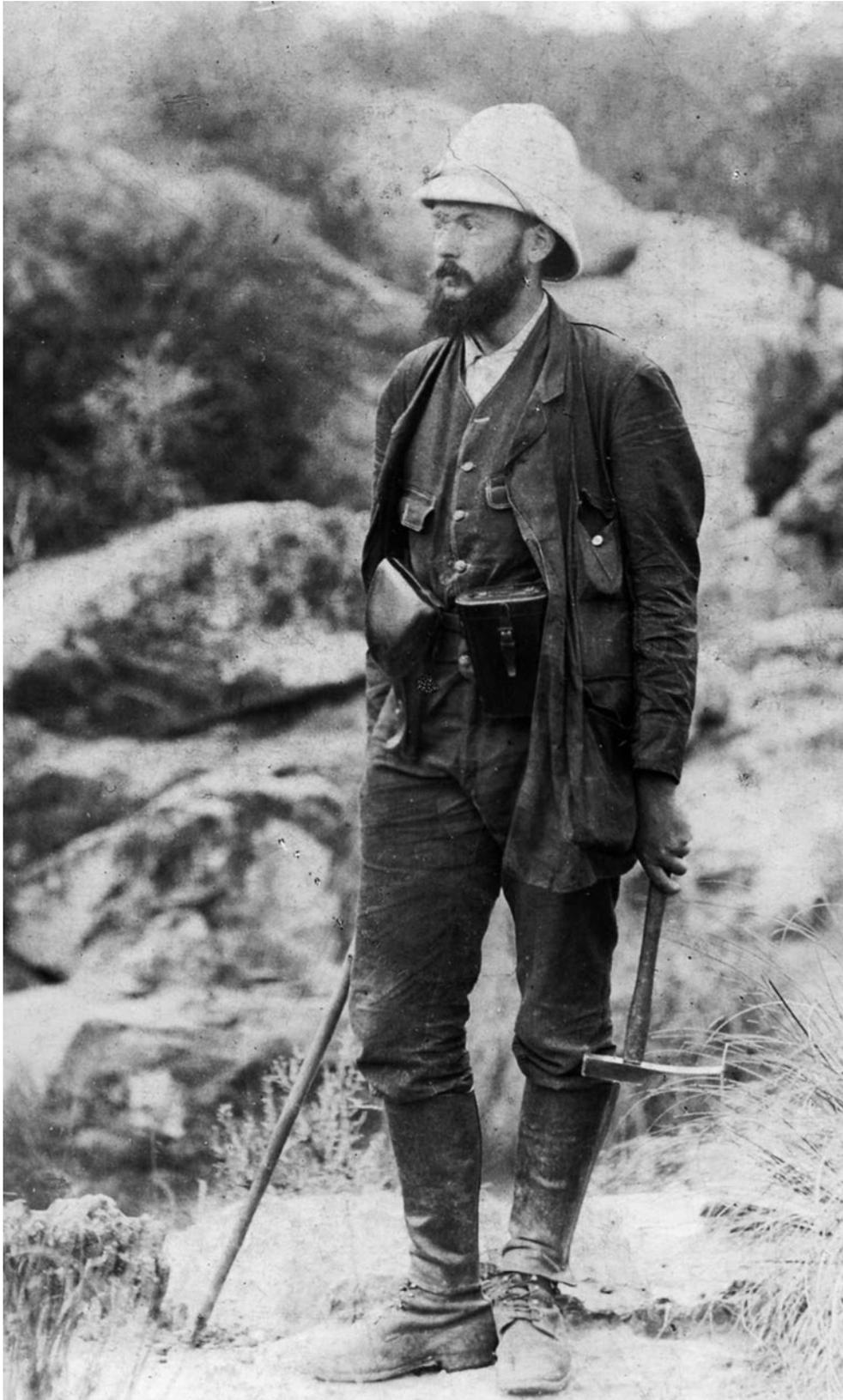
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Upper Albian and Cenomanian ammonites from Djebel Mrhila, Central Tunisia

W. J. KENNEDY¹ & A. S. GALE²



Léon Pervinrière in the field: Foug el Guelta in southern Djebel Mrhila, Central Tunisia, November 1897
(from Godard & Viaud, 2007, p. 81).

Upper Albian and Cenomanian ammonites from Djebel Mrhila, Central Tunisia

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Abstract

Sixty-five ammonite species are recognised in the upper Upper Albian and Cenomanian succession exposed in the southern part of Djebel Mrhila in Central Tunisia, based on new collections and material described by Léon Pervinquier in his benchmark publications on the area. The record is discontinuous, but the key marker species of a series of standard zones and subzones recognised in Western Europe are present, and allow recognition of the *Mortoniceras* (*Subschloenbachia*) *perinflatum* Zone of the upper Upper Albian, the *Neostlingoceras* *carcitanense* and *Sharpeiceras* *schlueteri* Subzones of the Lower Cenomanian *Mantelliceras* *mantelli* Zone, the *Cunningtoniceras* *inermis* and *Acanthoceras* *rhotomagense* Zones of the Middle Cenomanian (and the *Turrilites* *costatus* and *T. acutus* Subzones of the latter), together with the *Calycoceras* *guerangeri* and *Neocardioceras* *juddii*/*Pseudaspidoceras* *pseudonosoides* Zones of the Upper Cenomanian. The presence of common *Hyphoplites*, a typical Boreal genus in the *carcitanense* Subzone is of note, as is the co-occurrence of *Cunningtoniceras* and *Acanthoceras* *rhotomagense* (Brongniart, 1822) in Tunisia, not seen in Western Europe. One species, *Lotzeitites* *elegans*, is new, and *Calycoceras* (*Newboldiceras*) *tunisiense* is proposed as a *nomen novum* for *Acanthoceras* *asiaticum* *tunetana* of Pervinquier, 1907, the stillborn homonym of *Acanthoceras* *confusum* *tunetanum* of Pervinquier, 1907.

Keywords

Ammonites, Albian, Cenomanian, Cretaceous, Tunisia.

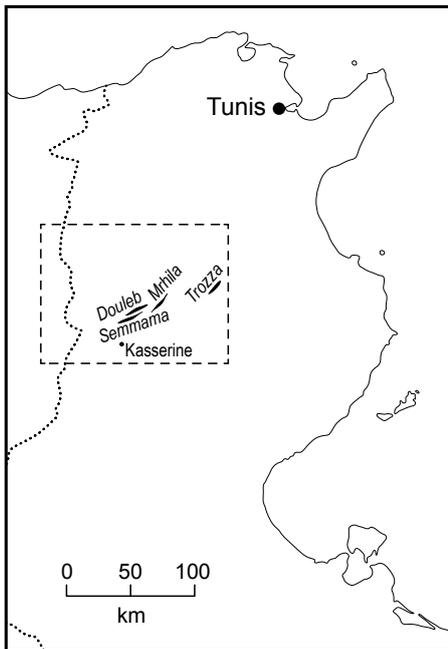
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1. INTRODUCTION

Djebel Mrhila is a 30 km long mountain in central Tunisia, 200 km south-south-west of Tunis, extending north-north-east from Sbeitla (Fig. 1). In the southern part of the mountain, an eroded anticlinal core extending

down to the Hauterivian-Valanginian Douleb and Mrhila Formations is exposed (Zghal & Arnaud, 2005), the succeeding Cretaceous extending to the Maastrichtian. The pioneering work of Léon Pervinquier (1873-1913: see the recent biography by Godard & Viaud, 2007) sets the benchmark for all subsequent work on the Cretaceous



of central Tunisia. Pervinquière's *Etude Géologiques de la Tunisie Centrale* (1903) covered an area of 18,000 km², and was followed by monographs of the *Céphalopodes des Terrains Secondaires* (1907), and *Gastropodes et Lamellibranches des Terrains Crétacés* (1912). A member of the staff of the Sorbonne, where he was Chef des Travaux Pratiques de Géologie, Pervinquière died at La Roche-sur-Yonne at the relatively early age of 39. There are comprehensive reviews of subsequent work on the Cretaceous of Central Tunisia in Robaszynski *et al.* (1990, 1993, 1994, 2000, 2008, 2010) as part of their detailed study of the Albian to Maastrichian successions in the Kalaat Senam area, 80 km to the north-west of Djebel Mrhila (Fig. 1), and the volume *Aptian-Turonian Events in central Tunisia* (Arnaud-Vanneau & Zghal, 2005).

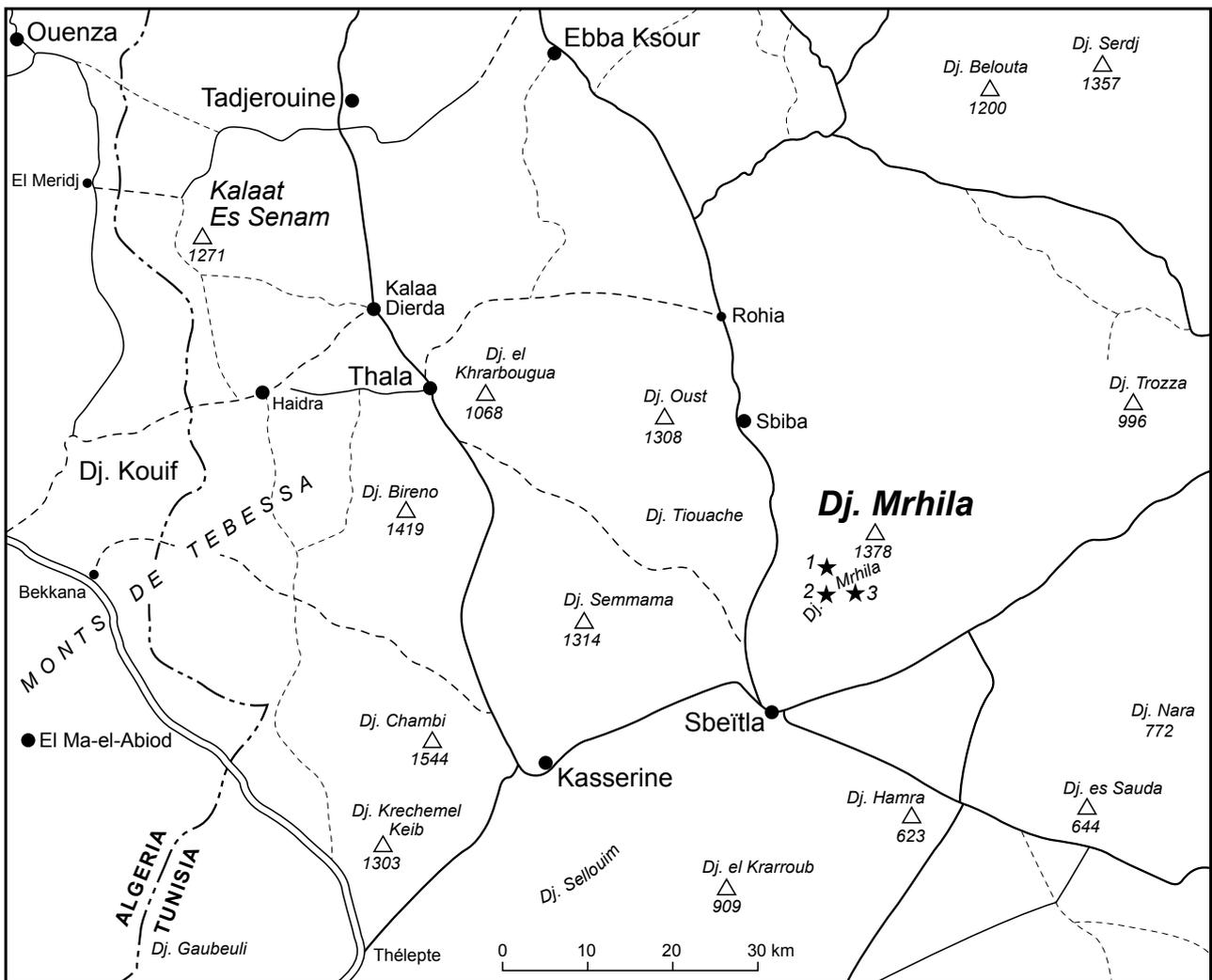


Fig. 1: Locality map for Central Tunisia, showing the location of Djebel Mrhila. The relative positions of 1: Sif et Tella, 2: Kef Si Abd el Kader, and 3: Foug el Guelta are indicated.

2. PALAEOGEOGRAPHIC SETTING

Pervinquier (1903) recognised three basic facies types in the Cenomanian of Central Tunisia, and his basic conclusions have been supported by subsequent workers. He recognised a southern association of dolomitic facies, represented at Djebel Semmama, Djebel Chambi and locations to the south (1903, p. 81). His central association (1903, p. 65 et seq.) was characterized by marls with minor calcareous and terrigenous-clastic intercalations (“argilo-marneuse et comporte seulement quelques intercalations calcaire et gréseuse”). The reference section was at Foug el Guelta in Djebel Mrhila, described below; his field sketch of the locality is reproduced here as Fig. 2 (Pervinquier’s portrait photograph, taken at this locality, is to be found on the cover and on p. 82 of Godard & Viaud, 2007, and forms the Frontispiece of this contribution). The third, northern association (1903, p. 71) consisting of marls and nodular limestones, was recognised at Djebel Bargou, Djebel Bou Kril, Guern er Rhezal, Djebel Si Abd el Kerim, and Pont du Fahs. Intermediate developments were also recognised between the northern and central associations, distributions summarized in a facies map (Pervinquier, 1903, fig. 16). Later palaeogeographic reconstructions, benefitting from the results of hydrocarbon exploration, confirm and expand this basic pattern (see for example Burrolet & Desforges, 1982; Marie *et al.*, 1984; Ben Ferjani *et al.*, 1990; Robaszynski *et al.*, 1994, and Fig. 3 herein).

3. BIOSTRATIGRAPHY

3.1. Ammonite zones

The faunas from Djebel Mrhila can be dated in terms of the zonal succession developed in Western Europe (Fig. 4);

these are assemblage zones and subzones. The Upper Albian scheme is based on the work of Amédéo (1992, 2002), Amédéo *et al.* (2004), Latil (1995) and Kennedy & Latil (2007), and is discussed by Gale *et al.* (2011). The Cenomanian sequence is based on Wright & Kennedy (1984), as modified by Gale (1989, 1995), and Gale & Friedrich (1995). See also Amédéo (1986), Amédéo & Robaszynski (1999) dealing with French sections, and Kaplan *et al.* (1998) and Wilmsen (2007), who discuss sequences in Germany. The Turonian sequence is based on Wright & Kennedy (1981), as modified by Gale *et al.* (2005).

Much of this sequence can be recognised across the north side of Tethys as far east as Turkmenistan.

Robaszynski *et al.* (1990, 1993, 1994, 2000, 2008, 2010) developed a zonal sequence for the Upper Albian, Cenomanian and Turonian mainly based on sections in the Kalaat Senan region, to the northwest of Djebel Mrhila. Their succession is of interval zones, taxon-range-zones, and partial range zones, and is also shown in Fig. 4, where a correlation between the two successions is suggested. The *Stoliczkaia africana* Zone is interpreted by Robaszynski *et al.* (2008) as the correlative of the *bracensis* Zone, and the Albian/Cenomanian boundary lies within this interval (Robaszynski *et al.*, 2008, text-fig. 5). The indices of the *azregensis* and *cobbani* Zones are currently known only from central Tunisia. The section across the *africana/azregensis* Zone boundary, illustrated in text-fig. 28 of Robaszynski *et al.* (1994, p. 411) shows a series of erosion events with phosphatised ammonite lags in channels. The *azregensis* Zone is just over a metre thick, with ammonites in scours at three levels, and *Sharpeiceras schlueteri* Hyatt, 1903, appearing 40 cm above the base of the Zone. *Neostlingoceras carcitanense* (Matheron, 1842) appears in a channel lag at the base of the *cobbani* Zone. The order of these first appearances is thus the reverse of that in the western European sequence. The base of the *dixonii* Zone is marked by the first and

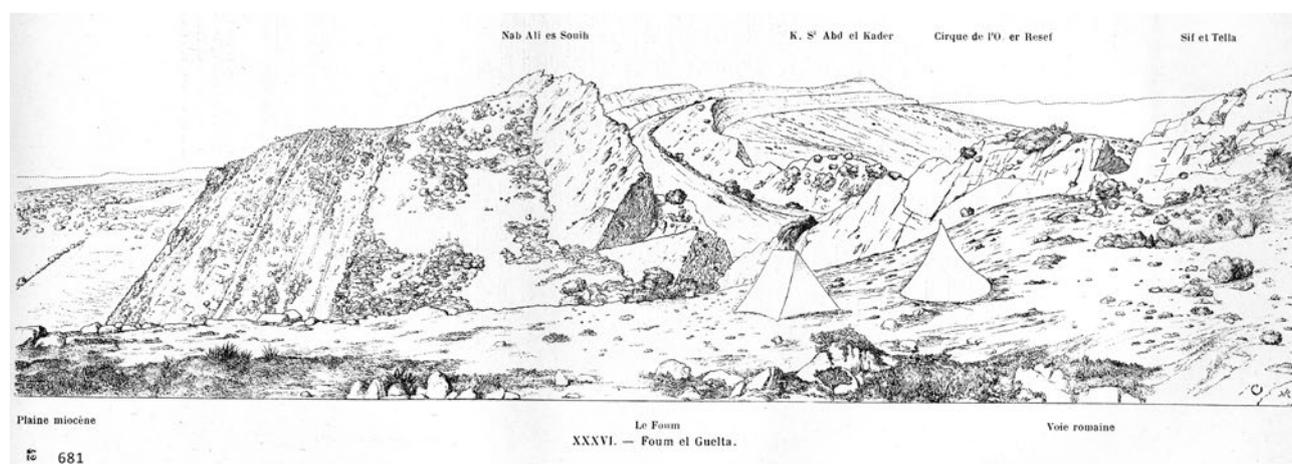


Fig. 2: The view from Foug el Guelta to Sif et Tella, Djebel Mrhila, copy of the lower figure of pl. 36, opposite p. 328 in Pervinquier, 1903.

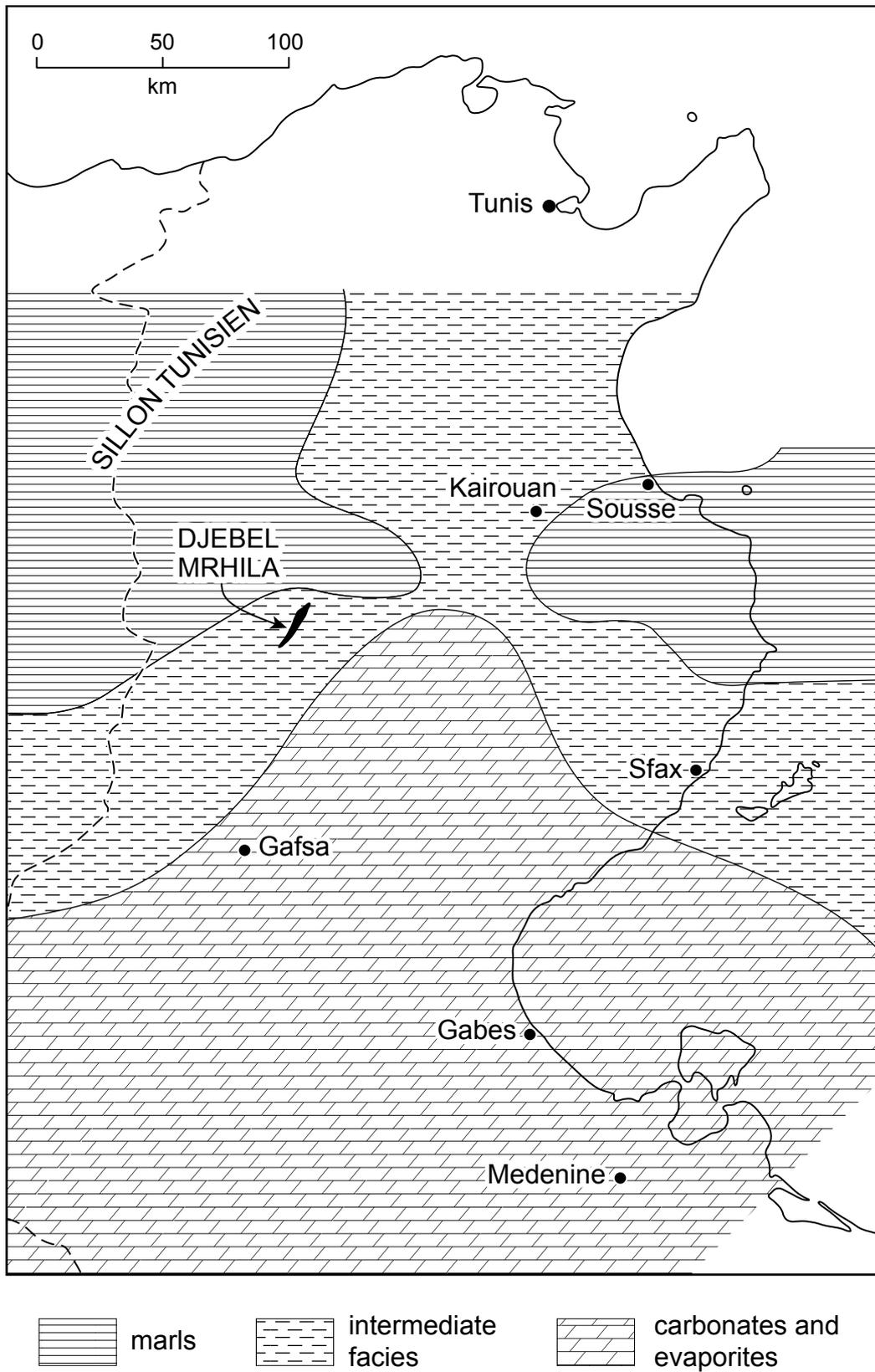


Fig. 3: Palaeogeographic map of Central Tunisia during the Cenomanian (modified after Robaszynski *et al.*, 2004, fig. 4).

SUBSTAGE	ZONE (W. EUROPE)	ZONE (KALAAAT SENAN)
LOWER TURONIAN (PART)	<i>Watinoceras devonense</i>	<i>Watinoceras</i> sp.
UPPER CENOMANIAN	<i>Neocardioceras juddii</i>	<i>Ps. pseudonodosoides</i>
	<i>Metoicoceras geslinianum</i>	<i>Metoicoceras geslinianum</i>
	<i>Calycoceras guerangeri</i>	<i>Eucalycoceras pentagonum</i>
MIDDLE CENOMANIAN	<i>Acanthoceras jukesbrownei</i>	<i>Acanthoceras amphibolum</i> <i>Paraconliniceras</i> cf. <i>barcusi</i>
	<i>Acanthoceras rhotomagense</i>	<i>Acanthoceras</i> cf. <i>rhotomagense</i>
	<i>Cunningtoniceras inerme</i>	<i>Cunningtoniceras inerme</i>
LOWER CENOMANIAN	<i>Mantelliceras dixonii</i>	<i>Mantelliceras dixonii</i>
	<i>Mantelliceras mantelli</i>	<i>Mantelliceras</i> cf. <i>mantelli</i>
		<i>Graysonites cobbani</i>
		<i>Graysonites azregensis</i>
<i>Pleurohoplites briacensis</i>	<i>Stol. (Shumarinaia) africana</i>	
UPPER ALBIAN (PART)	<i>Mortoniceras</i> (<i>Subschloenbachia</i>) <i>perinflatum</i>	<i>Mortoniceras</i> (<i>Subschloenbachia</i>) <i>perinflatum</i>
	<i>Mortoniceras</i> (<i>Subschloenbachia</i>) <i>rostratum</i>	<i>Mortoniceras</i> (<i>M.</i>) <i>fallax</i> (part)

Fig. 4: Uppermost Albian, Cenomanian, and basal Turonian ammonite zones recognised in Western Europe, and the Kalaat Senan region of Central Tunisia.

only occurrence of the index species in their sections. *Turrilites costatus* Lamarck, 1801, is recorded from the top of the *dixonii* Zone, whereas it first occurs at the base of the *costatus* Subzone of the *rhotomagense* Zone in Western Europe. This major anomaly appears to be based on misidentification. The juvenile *T. costatus* from the *dixonii* Interval Zone (Robaszynski *et al.*, 1994, pl. 13, figs 5, 7) is, in our view, a juvenile *Turrilites scheuchzerianus* Bosc, 1801. The base of the *inerme* Zone is defined by the first occurrence of *Cunningtoniceras* species in both Europe and Tunisia. The presence of *T. costatus* in the *inerme* Zone is an anomaly, perhaps explicable as above. The boundary between the *costatus* and *acutus* Subzones of the European *rhotomagense* Zone falls with the *Acanthoceras* gr. *rhotomagense* Interval Zone based on the last occurrence of the former and the first occurrence of the latter in the Kalaat Senan region. The fauna of the *barcusi* Interval Zone is Middle Cenomanian in aspect, as is that of the lower part of the *amphibolum* Total Range Zone. The presence of *Eucalycoceras pentagonum* (Jukes-Browne, 1896) at the top of the Zone suggests that this level is already Upper Cenomanian, as this is a *guerangeri* Zone species in Western Europe. The fauna of the *pentagonum* Partial Range Zone also indicates a correlation with the *guerangeri* Zone. The *Euomphaloceras septemseriatum* Interval Zone corresponds with part or all of the *geslinianum* Zone of Western Europe; Amédro *et al.* (2005) subsequently renamed this interval the *Metoicoceras geslinianum* Zone. The *pseudonodosoides* Interval Zone corresponds to the *Neocardioceras juddii* Zone of Western Europe on the basis of the co-occurrence of the two index species in New Mexico (Cobban, Hook & Kennedy, 1989).

3.2. The limits of the Cenomanian Stage

The base of the Cenomanian stage is defined at the first occurrence of the planktonic foraminiferan *Thalmaninella globotruncanoides* (Sigal, 1948), in the Marnes Bleues on the south side of Mont Risou east of Rosans, Haute-Alpes, France. The accepted definition of the boundary is given by Kennedy *et al.* (2004); the succession across the boundary interval is described in detail by Gale *et al.* (1996, 2011). Three groups provide the principal biostratigraphic markers for the boundary interval: ammonites, planktonic foraminifera, and nanofossils, with inoceramid bivalves (which are poorly represented in the Marnes Bleues of the Global Stratotype section) as a further group. The boundary lies within a major stable carbon isotope excursion, corresponding to Oceanic Anoxic Event 1D of authors, which allows the boundary to be recognised where key biostratigraphic indicators are absent, and provides an isochronous datum against which biostratigraphic correlations can be tested. There is no ammonite marker corresponding to the foraminiferal defined boundary; it falls within the poorly

characterized *Pleurohoplites briacensis* ammonite Zone of the Western European sequence, and the *Stoliczkaia (Shumarinaia) africana* Partial Range Zone of the Kalaat Senan sequence. There are a series of ancillary markers for the boundary in the Global Stratotype Section; those relevant to the present account are as follows, expressed in terms of distance below the top of the Marnes Bleues, after Kennedy *et al.* (2004), and incorporating revised occurrence data from Gale *et al.* (2011):

(youngest)

- The first occurrence of typically Cenomanian ammonites *Neostlingoceras oberlini*, *Mantelliceras mantelli*, *Hyphoplites curvatus* and *Sciponoceras roto* at -30 m.
- The only record of *Pleurohoplites briacensis* in the section (1 specimen) at -32 m.
- The last occurrence of the typically Albian ammonites *Lechites gaudini*, *Stoliczkaia clavigera*, *Mariella* cf. *miliaris* and *Hemiptychoceras subgaultinum* at -32 m.
- The base of the Cenomanian stage is defined at the level 36 m below the top of the Marnes Bleues, which corresponds to first occurrence of the planktonic foraminiferan *Thalmaninella globotruncanoides*.
- The last occurrence of the ammonite *Mariella bergeri* at -50 m.
- The last occurrence of the ammonite *Mortoniceras perinflatum* at -102.8 m.
- The last occurrence of the ammonite *Stoliczkaia dispar* at -119 m.

(oldest)

The boundary datum has been precisely documented in the Kalaat Senan area of central Tunisia, 80 km to the north-west of Djebel Mhrila (Robaszynski *et al.*, 2008). Here, the first occurrence of *Thalmaninella globotruncanoides* lies within a *Stoliczkaia (Shumarinaia) africana* partial range Zone, an interval of 34.5 m between the highest *Mortoniceras* and the lowest *Mantelliceras*, *Graysonites*, and *Hypoturrilites*. The assemblage from the zone is: *Phylloceras* sp., *Puzosia (Anapuzosia)* sp., *S. (S.) clavigera* Neumayr, 1875, *S. (Sh.) africana* Pervinquier, 1907, *Lechites gaudini* (Pictet & Campiche, 1861), *Idiohamites* sp., *Ostlingoceras* sp., *Mariella bergeri* (Brongniart, 1822), and *Scaphites* sp.

As in the Global Stratotype Section at Mont Risou, there is no ammonite marker that corresponds to the foraminiferal datum.

The base of the Turonian Stage is defined as the first occurrence of the ammonite *Watinoceras devonense* (Wright & Kennedy, 1981) at the base of bed 86 of the Bridge Creek Limestone Member of the Greenhorn Limestone Formation at the west end of the Denver and Rio Grande Railroad cutting near the north end of the Pueblo Reservoir State Park Recreation area west of Pueblo, Colorado. The accepted definition of the boundary is given by Kennedy *et al.* (2005a). Full details

of the section and key ammonite and inoceramid faunas are described by Cobban (1985), Cobban & Scott (1973), Kennedy & Cobban (1991), and Kennedy, Cobban, Elder & Kirkland (1999). The boundary also lies within a major carbon stable isotope excursion, Oceanic Anoxic Event 2. Key ammonite records in the Global Stratotype Section, after Kennedy *et al.* (2005a) relevant to the present discussion are as follows:

- The first occurrence of the ammonite *Metoicoceras geslinianum* at the base of bed 63, and last occurrence in bed 67.
- The first occurrence of the ammonite *Euomphaloceras septemseriatum* in bed 67 and last occurrence in bed 77.
- The first occurrence of the ammonite *Neocardioceras juddii* in bed 79, and its last occurrence in bed 84.
- The primary marker: the first occurrence of the ammonite *Watinoceras devonense* in bed 86.
- The first occurrence of the planktonic foraminiferan *Helvetoglobotruncana helvetica* in bed 89 (*H. prae-helvetica-helvetica* transitional forms occur in beds 85 and 87).
- The first occurrence of the ammonite *Mammites nodosoides* in bed 101, and its last occurrence in bed 118.

The Cenomanian/Turonian boundary interval in Tunisia has been the subject of intense study (see Robaszynski *et al.*, 2010 and references therein). In the region of Kalaat Senan, discussed above, and at many other sections in northern and central Tunisia, it falls within the Bahloul Formation, a sequence of black laminated limestones and marls with a high organic carbon content that represent Oceanic Anoxic Event 2. Detailed correlations of macrofaunas, microfaunas, and the $\delta^{13}\text{C}$ curve enable precise correlation with the Turonian GSSP at Pueblo, Colorado. The sequence is generally between 20 and 40 m in thickness; the ammonite sequence across the boundary is reviewed by Amédéo *et al.* (2005). A *Metoicoceras geslinianum* Zone, with the index species, *Pseudocalycoceras angolaense* (Spath, 1931), *Eucalycoceras pentagonum* and *Euomphaloceras septemseriatum* (Cragin, 1893) corresponds to the Western European *geslinianum* Zone. The succeeding *Pseudaspidoceras pseudonodosoides* Total Range Zone is equivalent to the *Neocardioceras juddii* Zone, in the overlying basal Turonian *Watinoceras* Zone, the first appearance of the genus is only 10 cm above the last occurrence of *P. pseudonodosoides* (Choffat, 1898) in a section near Bou Ghanem (the BGC section of Robaszynski *et al.*, 2010). It should be noted, however, that *Watinoceras* first appears in the *juddii* Zone in New Mexico (Cobban *et al.*, 1989). The succeeding *Pseudaspidoceras flexuosum* Zone yields the index species, *Watinoceras* sp., and *Fagesia* sp.

The Cenomanian/Turonian boundary interval in the Kasserine region is documented by Meister & Abdallah (2012). Their Jabal Semmama section (*loc. cit.*, text-

fig. 6) yielded an uppermost Cenomanian fauna of *Pseudocalycoceras* sp., *Nigericeras* aff. *gadeni* (Chudeau, 1909), *N. jacqueti* Schneegans, 1943, *Vascoceras* cf. *barcoicensis exile* Cobban, Hook & Kennedy, 1989, *V.* cf. *barcoicense* Choffat, 1898, *V. gamai* Choffat, 1898, *V. ellipticum* (Barber, 1957, and *Pseudaspidoceras* gr. *pseudonodosoides* from the summit of the Fahdène Formation, a more diverse assemblage than that of the *pseudonodosoides* Zone of the Bahloul Formation noted above, with taxa known from sections in Portugal, and Niger. A discontinuity separates this assemblage from Lower Turonian Marnes d'Annaba, with *Kamerunoceras* (?), *Watinoceras*, and *Neoptychites* gr. *cephalotus* (Courtillet, 1860) at the base. Their Oum Debane section (2012, fig. 3) yielded a sequence at the top of the Fahdène Formation of:

(youngest)

3. *Pseudaspidoceras* gr. *pseudonodosoides*, *N. gadeni*, *N.* aff. *scotti* Cobban, 1962, *Vascoceras* sp., and *V. douvillei* Choffat, 1898.
2. *Euomphaloceras* aff. *septemseriatum*, *Rubroceras* gr. *burroense* Cobban, Hook & Kennedy, 1989, *N. gadeni*, *N. jacqueti*, *N. jacqueti involutus* Meister, Alzouma, Lang & Mathey, 1992, *N.* aff. *scotti*, and *V. barcoicense exile* Cobban, Hook & Kennedy, 1989.
1. *Eucalycoceras* sp., *Euomphaloceras* aff. *septemseriatum*, *Rubroceras* gr. *burroense* Cobban, Hook & Kennedy, 1989, *R.* sp., and *Nigericeras gadeni*.

Faunas 1 and 2 appear to correspond to the *Burroceras clydense* Zone that lies between the *Sciponoceras gracile* Zone (the correlative of the Western European *Metoicoceras geslinianum* Zone) and the *Neocardioceras juddii* Zone in New Mexico (Cobban *et al.*, 1989).

In the Gafsa region of south-central Tunisia, Meister & Abdallah (2005) recognised the following sequence across the Cenomanian/Turonian boundary. A *Neolobites vibrayeanus* Zone, corresponding to part of the Western European *guerangeri* Zone, with a distinction between a lower interval with *N. vibrayeanus* (*d'Orbigny*, 1841) and an upper interval with *N. vibrayranus brancai* Eck, 1908. Above, a *Metoicoceras geslinianum* Zone yielded a lower association of *M. geslinianum* (*d'Orbigny*, 1850) and *Thomelites* (?) *numidicus* Meister & Abdallah, 2005, and an upper association of *Nigericeras* sp., and *Burroceras* (?) aff. *irregulare* Cobban Hook & Kennedy, 1989. The succeeding *Pseudaspidoceras pseudonodosoides* Zone yielded only the index species, and again correlates with the *juddii* Zone. An assemblage with *Vascoceras gamai* and *Pseudaspidoceras paganum* Reyment, 1955, is problematic; *V. gamai* is Upper Cenomanian in Portugal, but *P. paganum* is Lower Turonian in Nigeria (Zaborski, 1985).

3.3. Cenomanian Substages

There is no formal agreement on Substage boundaries within the Cenomanian Stage. The matter was discussed at the 1995 Symposium on Cretaceous Stage Boundaries (Rawson *et al.*, 1996; Tröger & Kennedy, 1996), and the position adopted here is that the base of the Middle Cenomanian is taken at the first occurrence of the ammonite *Cunningtoniceras inerme* (Pervinquière, 1907), and the base of the Upper Cenomanian at the last occurrence of the ammonite *Acanthoceras jukesbrownei* (Spath, 1926a). The former corresponds to the onset a carbon stable isotope excursion, the mid-Cenomanian event of Paul *et al.* (1994). The base of the Middle Cenomanian can be recognised in Central Tunisia on the basis of the first occurrence of *C. inerme* and other *Cunningtoniceras* species. The position of the base of the Upper Cenomanian is less readily established, in the absence of the index species. As noted above, the presence of the *guerangeri* Zone species *Eucalycoceras pentagonum* and *Lotzeites* sp. in the upper part of the *Acanthoceras amphibolum* Total Range Zone in the Kalaat Senan sections indicates that the base of the Upper Cenomanian lies at this level.

Such a conclusion is at variance with the dating of the *amphibolum* Zone in the United States, where in both New Mexico (Kennedy *et al.*, 1988) and northeast Texas (Kennedy & Cobban, 1990), it yields *Turrilites acutus* (Passy, 1832) and is regarded as Middle Cenomanian.

4. LOCALITY DETAILS

We investigated two sections in connection with this study, south of Sif et Tella, and at Fom el Guelta, both sections studied by Pervinquière, and the source of many of the ammonites and other fossils described and figured by him.

4.1. South of Sif et Tella

The section shown in Fig. 5 was measured by the late J. M. Hancock in 1978 and 1984, while in the company of WJK, in the area between Sif et Tella and Kef Si Abd el Kader, 35 km north-north-east of Sbeitla. Pervinquière drew his section (1903, fig. 15) below Kef Si Abd el Kader; his panorama is reproduced here as Fig. 2. The coordinates, based on the Paris Meridian are 39° 66.55' N, 7° 66.55' E.

The upper part of the Fahdene Formation consists predominantly of grey marls with occasional laterally persistent dolomitic limestones, rubbly nodular limestones, and marls with nodular, micritic limestones. A significant part of the sequence is obscured by superficial deposits. Ammonite occurrences are summarized in Table 1.

Table 1: Ammonite occurrences in the section south of Sif et Tella.

Sif et Tella	3	5	6	7	8	9	10	13
<i>H. falcatus aurora</i>	*							
<i>N. fourtaui</i>					*		*	
<i>F. cf. beaumontianum</i>				*				
<i>F. flicki</i>							*	
<i>F. chevillei</i>					*			
<i>M. mantelli</i>			*	*				
<i>M. lymense</i>		*						
<i>M. saxbii</i>		*						
<i>M. couloni</i>		*						
<i>G. cherbensis</i>	*							
<i>G. azregensis</i>				*				
<i>S. laticlavium</i>				*				
<i>S. schlueteri</i>		*						
<i>S. florencae</i>		*						
<i>S. mocambiquense</i>		*						
<i>Sharpeiceras</i> spp. indet.		*						
<i>A. renevieri</i>					*		*	
<i>Ac. rhotomagense</i>							*	
<i>C. inerme</i>						*	*	
<i>C. meridionale</i>					*			
<i>C. africanum</i>					*		*	
<i>Cunningtoniceras</i> sp.							*	
<i>Cunningtoniceras</i> sp. juv.					*			
<i>C. (G.) cf. gentoni</i>					*		*	
<i>C. (N.) a. spinosum</i>							*	
<i>C. (Newboldiceras?) sp.</i>							*	
<i>E. batnense</i>								*
<i>A. ellipticus</i>	*							
<i>M.(M.) aff. dorsetensis</i>				*				
<i>M.(M.) cf. oehlerti</i>	*							
<i>T. scheuchzerianus</i>					*			
<i>T. costatus</i>							*	
	3	5	6	7	8	9	10	13

Bed 2 is a laterally extensive dolomitic limestone. Bed 3 is a sequence of grey marls, an estimated 50 m thick, largely concealed by superficial deposits. The lower part yielded a small collection of limonitic ammonites: *Hyphoplites falcatus aurora* Wright & Wright, 1949, *Graysonites cherbensis* (Thomas & Peron, 1889), *Mariella (M.) cf. oehlerti* (Pervinquière, 1910), and *Algerites ellipticus* (Mantell, 1822). This is a Lower Cenomanian association; *A. ellipticus* is restricted to the *carcitanense* Subzone of the *mantelli* Zone in Western Europe, and precisely dates the lower part of the unit. Bed 4 is a laterally extensive rubbly limestone. The base of bed 5 is a nodular rubbly limestone, passing up into marls with limestone nodules,

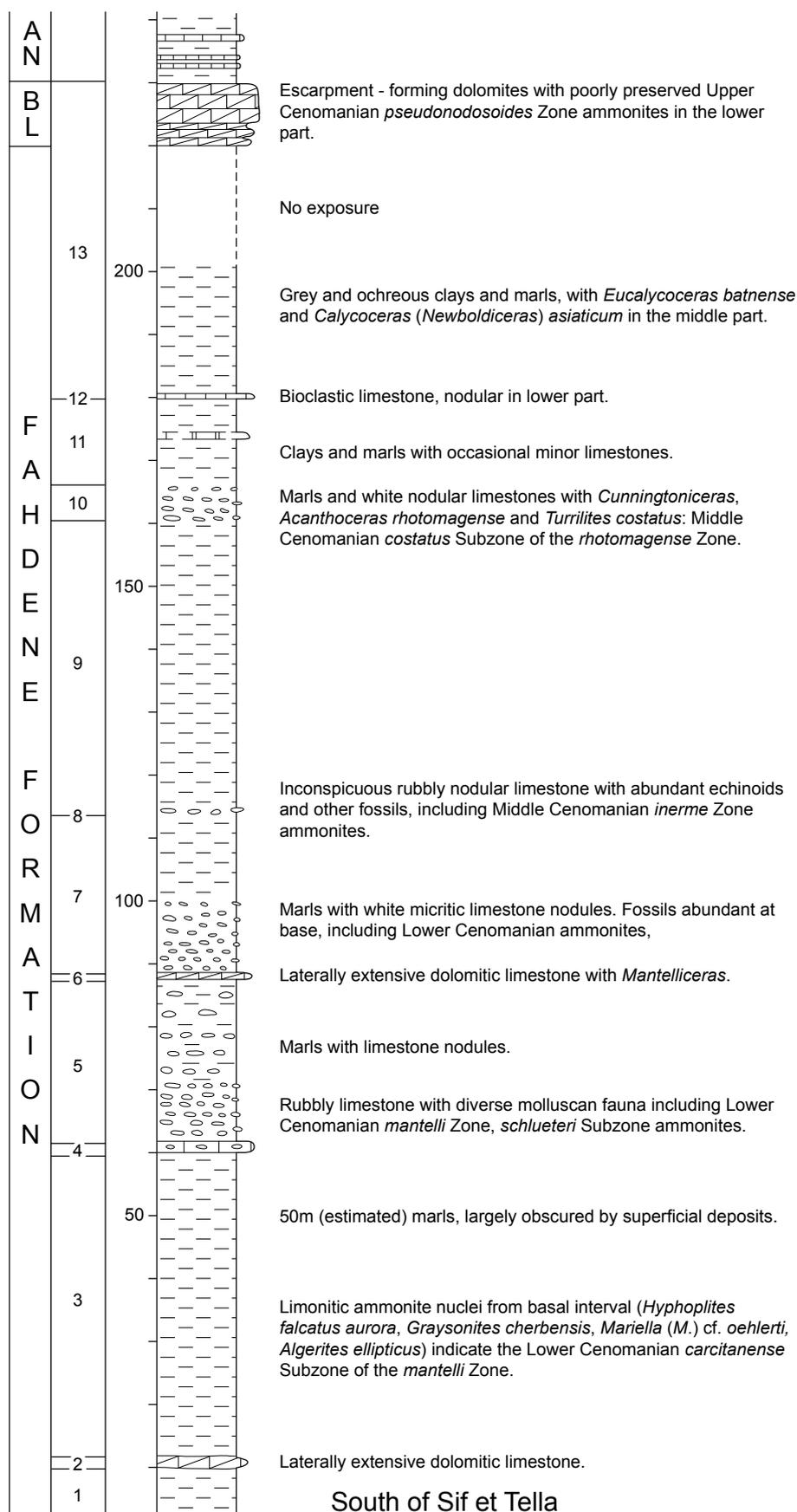


Fig. 5: The Cenomanian and basal Turonian succession south of Sif et Tella, Djebel Mrhila, base on the field notebooks of the late J. M. Hancock.

which decrease in abundance upwards. The basal part is richly fossiliferous, and dominated by bivalves and gastropods, including *Amphidonte flabellatum* (Goldfuss, 1837), '*Lopha*' *syphax* (Coquand, 1854), *Neithea shawi* Pervinquier, 1912, *Plicatulaourneli* Coquand, 1862, *Trigonarca thevestensis* (Coquand, 1862), *Pterotrigonia* sp., *Pterodonticeras dutrugi* (Coquand, 1862), *Strombus incertus* (d'Orbigny, 1843), and *Mrhilaia haugi* Pervinquier, 1912, together with the echinoid *Hemiasperter heberti* Peron & Gauthier, 1878. The ammonite assemblage is: *Mantelliceras lymense* (Spath, 1926b), *M. saxbii* (Sharpe, 1857), *Sharpeiceras schlueteri* Hyatt, 1903, *S. florencae* Spath, 1925, and *S. mocambiquensis* Choffat, 1903. This association indicates the *schlueteri* Subzone of the *mantelli* Zone of the Western European sequence, and the *cobbani* Zone of the Kalaat Senan sections.

Bed 6 is a laterally extensive dolomitic limestone, with abundant '*Lopha*' *syphax*, rudist fragments, *Cerithium tenouklense* (Coquand, 1862), *Neohibolites* sp., common *Mecaster batnensis* (Coquand, 1862), and *Heterodiadema libyca* (Desor, 1846) (in Agassiz & Desor, 1846) common. The presence of *Mantelliceras mantelli* (J. Sowerby, 1814) indicates nothing more precise than Lower Cenomanian.

Bed 7 consists of marls with nodules of white micritic limestone that decrease in abundance upwards. Fossils are abundant at the base, with *Neithea shawi* abundant, accompanied by *Amphidonte flabellatum*, *Exogyra olisiponensis* (Sharpe, 1850), *Plicatulaourneli*, rare rudist fragments, *Pterodonticeras dutrugi*, and *Strombus incertus*. The ammonites present are *Forbesiceras* cf. *beaumotianum* (d'Orbigny, 1841), *Mantelliceras mantelli* *Graysonites cherbensis*, *Sharpeiceras laticlavium* (Sharpe, 1855), and *Mariella* (*M.*) aff. *dorsetensis* Spath, 1926b. This is a Lower Cenomanian association.

Bed 8 is an inconspicuous but richly fossiliferous rubbly limestone. The fauna is dominated by echinoids, with *Mecaster batnensis* (Coquand, 1862) common, and scarcer *Tetragramma marticense* Cotteau, 1864, together with '*Corbis*' sp., *Dosinia delectrei* (Coquand, 1862), *Sauvagesia nicasei* (Coquand, 1862), *Strombus incertus*, and *Pterodonticeras dutrugi*. Nautiloids present are *Eutrephoceras* sp., *Angulithes triangularis* Montfort, 1808, and *Cymatoceras calabrense* (Seguenza, 1881). The ammonites are *Neolobites fourtaui* Pervinquier, 1907, *Forbesiceras chevillei* (Pictet & Renevier, 1866), *Acompsoceras renevieri* (Sharpe, 1857), *Cunningtoniceras meridionale* (Stoliczka, 1864), *C. africanum* (Pervinquier, 1907), *C.* sp. juv., *Calycoceras* (*Gentoniceras*) cf. *gentoni* (Brongniart, 1822), and *Turrilites scheuchzerianus* Bosc, 1801. The presence of *Cunningtoniceras* indicates the lower Middle Cenomanian *inerme* Zone.

The marls with occasional limestones of bed 9 yielded *Cunningtoniceras inerme* (Pervinquier, 1907). The

succeeding marls and white nodular micritic limestones of bed 10, with large arcid bivalves and *Pterodonticeras*, yield the most diverse ammonite assemblage in the sequence: *Neolobites fourtaui*, *Forbesiceras flicki* Pervinquier, 1907, *Acompsoceras renevieri*, *Acanthoceras rhotomagense* (Brongniart, 1822), *Cunningtoniceras inerme*, *C. africanum*, *Cunningtoniceras* sp., *Calycoceras* (*Gentoniceras*) cf. *gentoni*, *Calycoceras* (*Newboldiceras*) *asiaticum spinosum* (Kossmat, 1897), *Calycoceras* (*Newboldiceras*?) sp., and *Turrilites costatus* Lamarck, 1801. The co-occurrence of *Acanthoceras rhotomagense* and *Turrilites costatus* indicate the lower, *costatus* Subzone of the Middle Cenomanian *rhotomagense* Zone. Ammonites are rare in the poorly exposed Fahdene Formation above this level, with a single fragment of *Eucalycoceras batnense* (Collignon, 1937) from the middle of bed 13, suggesting upper Middle or lower Upper Cenomanian. In contrast, there are many poorly preserved, frequently solution-modified and distorted ammonites in the succeeding dolomites (Bed 14), the local equivalent of the Bahloul Formation. Indeterminate vascoceratids (OUM KX328-333, 335-7, 340) are common, with scarcer *Pseudaspidoceras* cf. *pseudonodosoides* (Choffat, 1898) (OUM KX334, 341, and 737) in the lower few metres, indicate the upper Upper Cenomanian *Neocardoceras juddi*/*Pseudaspidoceras pseudonodosoides* Zone. The lower part of the succeeding Annaba Formation yielded Lower Turonian *Pseudaspidoceras flexuosum* Powell, 1963, *Vacoceras durandi* (Thomas & Peron, 1889), *Fagesia* sp., and indeterminate Mammitinae (Chancellor *et al.*, 1994, p. 13, text-fig. 5).

4.2. Foum el Guelta

Foum el Guelta is the pass some 18 km north-east of Sbeitla, where the Oued el Guelta emerges onto the plain to the southeast of Djebel Mhrila, the coordinates, based on the Paris meridian are 39° 66. 55' N, 7° 60' E. Pervinquier's section (1903, p. 95, text-fig. 14, pl. 36) appears to have been measured south-south-west of the Foum. The section here (Fig. 6) was measured by A. S. G. in 1988. Ammonite occurrences are summarised in Table 2.

The succession in the Fahdene Formation comprises marls (which entirely dominate the lower part of the succession: 0-190 m, beds 2-6). These yield limonitic and calcitic nuclei of ammonites, whereas the rubbly nodular limestones (beds 3, 5) yield larger, poorly preserved composite molds. In the upper part of the Fahdene Formation, flaggy bioclastic limestones are present (beds 14, 16, 18), which locally yield ammonites.

Bed 2 yielded small limonitic *Graysonites cherbensis* (Thomas & Peron, 1889), 23-28 m above the base, and *Hyphoplites falcatus aurora*, *G. cherbensis*, *Neostlingoceras oberlini* (Dubourdieu, 1953), 40-47 m

Table 2: Ammonite occurrences in the Foug el Guelta section.

Foug el Guelta	1	2	3	5	7	8	9	13	14	17	19	20
<i>Pachydesmoceras</i> sp.											*	
<i>D.</i> cf. <i>latidorsatum</i>			*									
<i>H. falcatus aurora</i>		*	*									
<i>N. peroni</i>											*	
<i>N. fourtaui</i>						*	*					
<i>S. (L.)</i> cf. <i>sanctaecatherinae</i>				*								
<i>F.</i> cf. <i>beaumontianum</i>				*								
<i>F.</i> cf. <i>obtectum</i>								*			*	
<i>F. chevilliei</i>						*						
<i>M. mantelli</i>					*							
<i>M. cantianum</i>					*							
<i>M. lymense</i>				*	*							
<i>M. couloni</i>												
<i>G. cherbensis</i>		*	*									
<i>G. azregensis</i>			*	*								
<i>U.</i> cf. <i>discooidale</i>			*	*								
<i>M. lapparenti</i>								*	*	?		
<i>S. schlueteri</i>			*	*	*							
<i>S. mocambiquense</i>				*								
<i>Sharpeiceras florencae</i>				*								
<i>A. renevieri</i>						*	*					
<i>A. inconstans</i>						*						
<i>Ac. rhotomagense</i>								*				
<i>C.</i> cf. <i>meridionale</i>								*				
<i>C. africanum</i>							*					
<i>C.</i> spp.juv.							?	*				
<i>C.</i> sp. indet.							*					
<i>C. tinrhertense</i>										*	*	
<i>C. (C.) naviculare</i>											*	
<i>C. (G.) boehmi</i>								*				
<i>C. (N.) a. asiaticum</i>								*	*	*	*	
<i>C. (N.) a. spinosum</i>								*				
<i>C. (N.) planecostatum</i>									*	?		
<i>C. (N.)</i> cf. <i>vergonsense</i>								*				
<i>P. haugi</i>								*				
<i>P. jullieni</i>								*	?	*		
<i>E. pentagonum</i>											*	
<i>E. batnense</i>								*				
<i>T. sornayi</i>									*			
<i>L. elegans</i>								*				
<i>P.</i> cf. <i>pseudonodosoides</i>												*
<i>M.</i> cf. <i>oehlerti</i>			*									
<i>N. oberlini</i>		*										
<i>H.</i> cf. <i>gravesianus</i>						*						
<i>H. laevigatus</i>							*					
<i>T. scheuchzerianus</i>							*					
	1	2	3	5	7	8	9	13	14	17	19	20

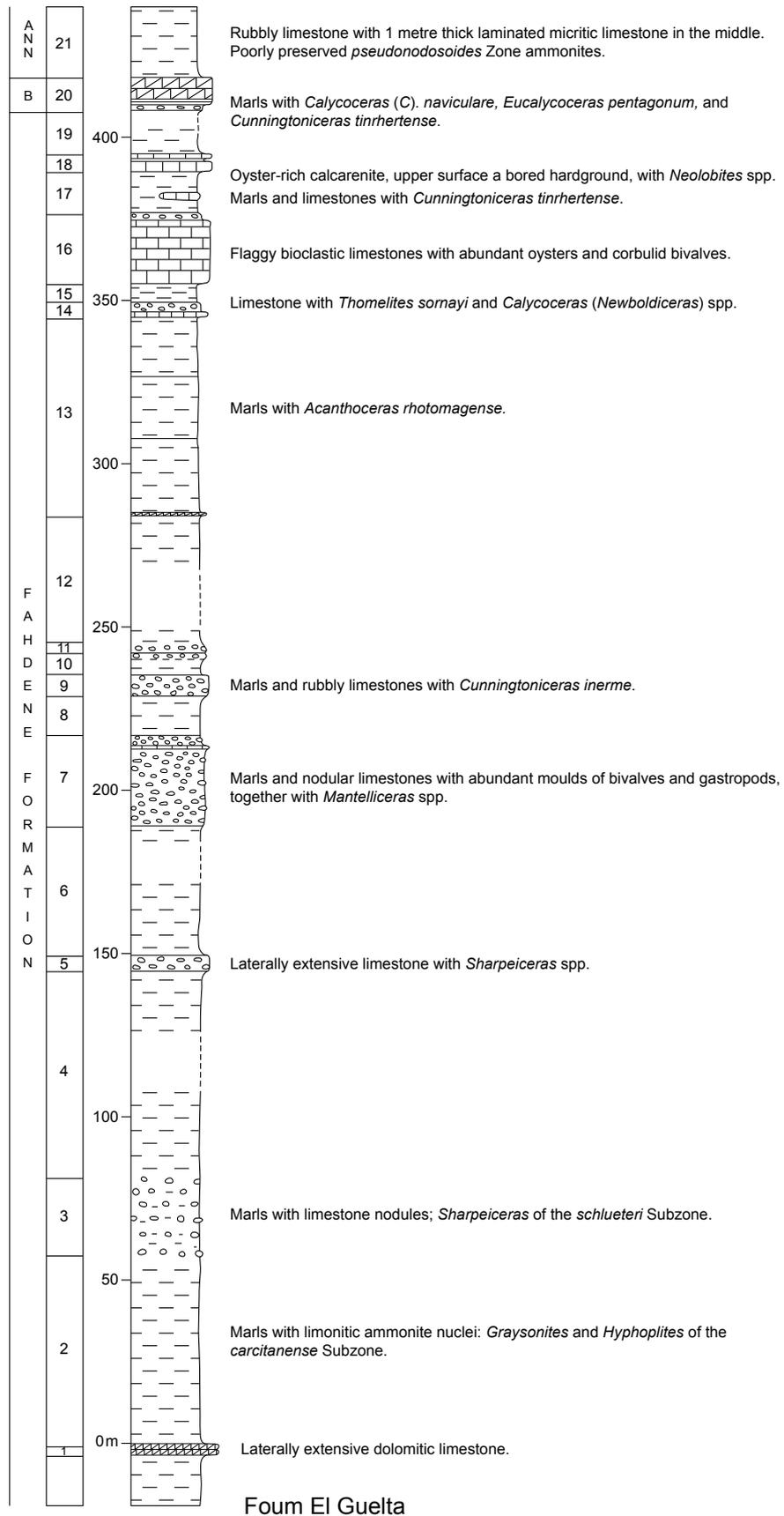


Fig. 6. The Cenomanian and basal Turonian succession at Fom el Guelta, Djebel Mrhila.

above the base, indicating the *carcitanense* Subzone of the Western European *mantelli* Zone. Bed 3 yielded *Desmoceras* (*D.*) cf. *latidorsatum* (Michelin, 1838), common *H. falcatus aurora* (28 specimens), *Graysonites cherbensis*, *G. azregensis* (Amédro, 1994), *Utaturiceras* cf. *discoideale* (Kossmat, 1895), *Sharpeiceras schlueteri* Hyatt, 1903, and *M. (M.)* cf. *oehlerti*, indicating the Western European *schlueteri* Subzone of the *mantelli* Zone and the *cobbani* Zone of the Kalaat Senan region.

Bed 5 yielded *Neolobites* sp. indet., *Stoliczkaiella* (*Lamnayella*) cf. *sanctaecatherinae* Wright & Kennedy, 1978, *G. azregensis*, *Utaturiceras* cf. *discoideale*, *Sharpeiceras schlueteri*, *S. mocambiquense* (Choffat, 1903), and *S. florencae*, also indicating the *schlueteri* Subzone. Bed 7 yielded *Neolobites* sp. indet., *Mantelliceras mantelli*, *M. cantianum* Spath, 1926a, and *M. lymense* (Spath, 1926b); it can be dated no more precisely than Lower Cenomanian.

Bed 8, with *Neolobites fourtaui*, *Foresiceras chevillei*, *Acompsoceras renevieri*, *A. inconstans* (Schlüter, 1871) and *Hypoturrilites* cf. *gravesianus* (d'Orbigny, 1841) is also within the Lower Cenomanian, but lacks unequivocal diagnostic zonal/subzonal marker species. Also present are the nautiloids *Eutrephoceras* sp., *Angulithes triangularis*, and *Cymatoceras calabrense*.

Bed 9 yielded *N. fourtaui*, *A. renevieri*, *Cunningtoniceras meridionale*, *C. africanum*, *C.* spp. juv. and indet., *Hypoturrilites laevigatus* (Coquand, 1862), and *Turrilites scheuchzerianus*, indicating the lower Middle Cenomanian *inermis* Zone.

The lower part of bed 13 yielded *Neolobites* sp. indet., *Forbesiceras* cf. *obtectum*, *Mhriliceras lapparenti* (Pervinquier, 1907), *Acanthoceras rhotomagense*, *Cunningtoniceras* cf. *meridionale*, *C.* spp. juv., *Calycoceras* (*Gentoniceras*) *boehmi* (Spath, 1926b), *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), *C. (N.) asiaticum spinosum*, *C. (N.)* cf. *vergonsense* (Collignon, 1937), *Pseudocalydoceras haugi* (Pervinquier, 1907), *P. jullieni* (Collignon, 1937), *P. judaicum* (Taubenhaus, 1920), *Eucalycoceras batnense* (Collignon, 1937) and *Lotzeitites elegans* sp. nov. This is a *rhotomagense* Zone association, based on the presence of the index species. Also present is the nautiloid *Eutrephoceras* sp.

Bed 14, with *M. lapparenti*, *C. (N.) asiaticum asiaticum*, *C. (N.) planecostatum*, *Thomelites sornayi* (Thomel, 1966); bed 17 with *Cunningtoniceras tinrhertense* (Collignon, 1965), *C. (N.) asiaticum asiaticum*, *Pseudocalydoceras haugi* (Pervinquier, 1907), and the base of bed 19, with *Neolobites peroni* Hyatt, 1903, *N.* sp. indet., *F.* cf. *obtectum*, *Cunningtoniceras tinrhertense*, *Calycoceras* (*C.*) *naviculare*, *C. (N.) asiaticum asiaticum*, and *Eucalycoceras pentagonum* (Jukes-Browne, 1896) all belong to the lower Upper Cenomanian *guerangeri* Zone of the Western European sequence, and, as discussed above, the upper part of the *amphibolum* Zone and part or all of the *pentagonum* Zone of the Kalaat

Senan area. Also present is the nautiloid *Angulithes mermeti* (Coquand, 1862) in beds 17 and 19.

The lower part of bed 20, the dolomites of the Bahloul Formation, with specifically indeterminate vascoceratids and *Pseudaspidoceras* cf. *pseudonodosoides* belong to the upper Upper Cenomanian *juddii/pseudonodosoides* Zone.

5. STRATIGRAPHIC CONCLUSIONS

The ammonite succession in the southern part of Djebel Mrhila, based on material described by Pervinquier (1903, 1907), and our own collections spans an interval from the upper Upper Albian *Mortonoceras* (*Subschloenbachia*) *perinflatum* Zone to the uppermost Cenomanian *Neocardioceras judii/Pseudaspidoceras pseudonodosoides* Zone, but is incomplete. Whether this is a reflection of the lack of exposure at some levels, primary absence, or non-preservation of ammonites, or all three, is unclear. A correlation between the two sections studied is shown in Fig. 7. Ammonite occurrences are summarized in Table 3. It should be noted that elements of the *Mantelliceras dixonii*, *Acanthoceras jukesbrownei*, and *Metoicoceras geslinianum* zones faunas have not been recognised in the sequences studied.

The lowest horizon recognised is the *perinflatum* Zone, based on specimens of *Placentoceras saadense* (Thomas & Peron, 1889), *Stoliczkaiella* (*S.*) *dispar* (d'Orbigny, 1841) and *M. (S.) perinflatum*, recorded by Pervinquier from his unit 1 (1903, p. 66, fig. 14; p. 68, fig. 15). We did not ourselves examine this level. Above, specimens of *P.* cf. *saadense*, *Stoliczkaiella* (*S.*) sp., and *Mariella* (*M.*) *bergeri* (Brongniart, 1822) from south of Foum el Guelta (OUM KX 813-6, 818-9), appear to be from unit 2 or 3 of Pervinquier (1903, p. 66). This is still an Albian assemblage; the number of specimens is small, and it may still be within the *perinflatum* Zone, although we note that *M. (M.) bergeri* ranges 52.8 m higher than *M. (D.) perinflatum* in the Col de Palluel sequence (Gale *et al.*, 2011, p. 70), only 28 m below the base of the Cenomanian, there (the first occurrence of *Thalmaninella globotruncanoides*).

There is no record of the *Stoliczkaiella* (*Lamnayella*) *africana* Partial Range Zone that straddles the Albian/Cenomanian boundary in the Kalaat Senan area. The lowest Cenomanian fauna occurs in bed 3 of the Sif et Tella section and beds 2-4 of the Foum el Guelta section, and indicates the lowest, *carcitanense* Subzone of the Western European Lower Cenomanian *mantelli* Zone; the occurrence of the typically Boreal genus *Hyphoplites* is of note.

Bed 5 of the Sif et Tella and Foum el Guelta sections both yield diverse *Sharpeiceras*, indicating the Western European *schlueteri* Subzone of the *mantelli* Zone. *Sharpeiceras* species are present in both the *azregensis* and *cobbani* Zones of the Kalaat Senan sequence, and

Table 3: Zonal distribution of ammonites in the Djebel Mrhila sections. Abbreviations are as follows: *M.p.*: *Mortoniceras perinflatum*; *S.a.*: *Stoliczkaella africana*; *M.m.*: *Mantelliceras mantelli*; *M.d.*: *Mantelliceras dixoni*; *C.i.*: *Cunningtoniceras inerme*; *A.r.*: *Acanthoceras rhotomagense*; *A.jb.*: *Acanthoceras jukesbrowni*; *C.g.*: *Calycoceras guerangeri*; *M.g.*: *Metoicoceas geslinianum*; *P.p.*: *Pseudaspidoceras pseudonodosoides*.

	<i>M.p.</i>	<i>S.a.</i>	<i>M.m.</i>	<i>M.d.</i>	<i>C.i.</i>	<i>A.r.</i>	<i>A.jb.</i>	<i>C.g.</i>	<i>M.g.</i>	<i>P.p.</i>
<i>Pachydesmoceras</i> sp.			*							
<i>D.</i> cf. <i>latidorsatum</i>			*							
<i>H. falcatus aurora</i>			*							
<i>N. fourtaui</i>			*		*	*				
<i>N. peroni</i>								*		
<i>P. saadense</i>	*									
<i>M. perinflatum</i>	*									
<i>A. remolinense</i>			*							
<i>S. dispar</i>	*									
<i>S.</i> cf. <i>sanctaecatherinae</i>			*							
<i>F.</i> cf. <i>beaumontianum</i>			*							
<i>F. obtectum</i>						*		cf.		
<i>F. flicki</i>						*				
<i>F. chevillei</i>					*					
<i>M. mantelli</i>			*							
<i>M. cantianum</i>			*							
<i>M. lymense</i>			*							
<i>M. saxbii</i>			*							
<i>M. couloni</i>			*							
<i>G. cherbensis</i>			*							
<i>G. azregensis</i>			*							
<i>U.</i> cf. <i>discoideale</i>			*							
<i>M. lapparenti</i>						*		*		
<i>S. laticlavium</i>			*							
<i>S. schlueteri</i>			*							
<i>S. florencae</i>			*							
<i>S. mocambiquense</i>			*							
<i>A. renevieri</i>			*		*	*				
<i>A. inconstans</i>			*							
<i>A.</i> sp. juv.?					*					
<i>A. rhotomagense</i>						*				
<i>C. inerme</i>						*				
<i>C. meridionale</i>					*	cf.				
<i>C. africanum</i>					*	*				
<i>C.</i> sp.?						*				
<i>C. tinrhertense</i>								*		
<i>Calyc. naviculare</i>								*		
<i>C. gentoni</i>					*	*				
<i>C. boehmi</i>						*				
<i>C.</i> cf. <i>lafouxense</i>								*		
<i>C. a. asiaticum</i>						*		*		
<i>C. a. spinosum</i>						*				
<i>C. planecostatum</i>								*		

	<i>M.p.</i>	<i>S.a.</i>	<i>M.m.</i>	<i>M.d.</i>	<i>C.i.</i>	<i>A.r.</i>	<i>A.jb.</i>	<i>C.g.</i>	<i>M.g.</i>	<i>P.p.</i>
<i>C. cf. vergonsense</i>						*				
<i>C. tunisiense</i>						?				
<i>C. sp.</i>						*				
<i>P. haugi</i>						*		*		
<i>P. judaicum</i>						*				
<i>P. jullieni</i>						*				
<i>E. pentagonum</i>								*		
<i>E. batnense</i>								?		
<i>T. sornayi</i>								*		
<i>P. pseudonodosoides</i>										*
<i>L. elegans</i>						*				
<i>A. cf. ellipticus</i>			*							
<i>N. carcitanense</i>			*							
<i>N. oberlini</i>			*							
<i>M. bergeri</i>	*									
<i>M. cf. oehlerti</i>			*							
<i>M. aff. dorsetensis</i>			*							
<i>H. laevigatus</i>					*					
<i>H. cf. gravesianus</i>			*							
<i>T. scheuchzerianus</i>					*					
<i>T. costatus</i>						*				
<i>T. acutus</i>						*				

precise correlation is not possible. The few Lower Cenomanian ammonites from bed 7 of the Sif et Tella section and beds 7 and 8 of the Foug el Guelta section do not allow more precise dating; there is no unequivocal evidence for the *saxbii* Subzone of the *mantelli* Zone or the *dixonii* Zone of the Western European sequence.

Above, the appearance of *Cunningtoniceras* in bed 8 of the Sif et Tella section and bed 9 of the Foug el Guelta section indicate the base of the lower Middle Cenomanian *Cunningtoniceras inerme* Zone of both the Western European and Kalaat Senan sequences. The presence of *Acanthoceras rhotomagense* and *Turrilites costatus* in bed 8 of the Sif et Tella section, and the former in bed 13 of the Foug el Guelta section indicates the *rhotomagense* Zone, and the lower, *costatus* Subzone of that zone in the Western European sequence, and the *rhotomagense* Zone of the Kalaat Senan section. There is no evidence for the succeeding *Acanthoceras jukesbrownei* Zone of the Western European sequence, or the *Paraconlinoceras aff. barcusi* and lower *Acanthoceras amphibolum* Interval Zones of the Kalaat Senan area.

There is a further major gap in the faunas from the section south of Sif et Tella, with no record of the Upper Cenomanian *guerangeri* and *geslinianum* Zones of the Western European sequence, or the upper *amphibolum*, *pentagonum* and *geslinianum* Zones of the Kalaat Senan sequence. In contrast, beds 14-19 of the Foug el Guelta section yield marker species of the *guerangeri*

Zone, but there are no indicators of the succeeding *geslinianum* Zone. In both sections, the lower part of the dolomites of the Bahloul Formation yield a poorly preserved representatives of the highest Cenomanian *Neocardioceras juddii/Pseudasidoceras*.

6. CONVENTIONS

Dimensions are given in millimetres: D = diameter; Wb = whorl breadth; Wh = whorl height; U = umbilicus; c = costal dimension; ic = intercostal dimension. Figures in parentheses are dimensions as a percentage of the diameter. The suture terminology is that of Korn *et al.* (2003): E = external lobe; A = adventive lobe (= lateral lobe, L, of Kullmann & Wiedmann, 1970); U = umbilical lobe; I = internal lobe.

7. REPOSITORIES OF SPECIMENS

BGS. GSM: British Geological Survey, Keyworth, Nottinghamshire.

BMNH: The Natural History Museum, London.

MNHP: Laboratoire de Paléontologie of the Muséum National d'Histoire Naturelle, Paris

OUM: Oxford University Museum of Natural History.

SMC: The Sedgwick Museum, Cambridge.

8. SYSTEMATIC PALAEOLOGY

(W. J. Kennedy)

Order Ammonoidea Zittel, 1884
 Suborder Ammonitina Hyatt, 1889
 Superfamily Desmoceratoidea Zittel, 1895
 Family Puzosiinae Spath, 1922b
 Subfamily Puzosiinae Spath, 1922b
 Genus *Pachydesmoceras* Spath, 1922b

Type Species: *Ammonites denisonianus* Stoliczka, 1865, p. 153, pl. 66a, by the original designation of Spath 1922b, p. 127.

***Pachydesmoceras* sp.**

Fig. 8

Material: OUM KX1880, from the base of bed 19 of the Fom el Guelta section.

Description and Discussion: The specimen is a 60° sector of phragmocone with a whorl height of 80 mm, the umbilicus deep, with a convex, outward-inclined umbilical wall and broadly rounded umbilical shoulder, the whorl section as wide as high, and oval. The flank ornament is poorly preserved, but the venter bears narrow, widely separated, feebly convex ribs. The fragment is specifically indeterminate, but such characters as are preserved compare well with those of the type species (see revision in Matsumoto *et al.*, in Matsumoto, 1988, p. 109, text-figs 48, 49, and Kaplan *et al.*, 1998, p. 80, pls 7, 8, text-fig. 36).

Occurrence: As for material.

Family Desmoceratidae Zittel, 1895
 Subfamily Desmoceratinae Zittel, 1895
 Genus and Subgenus *Desmoceras* Zittel, 1884

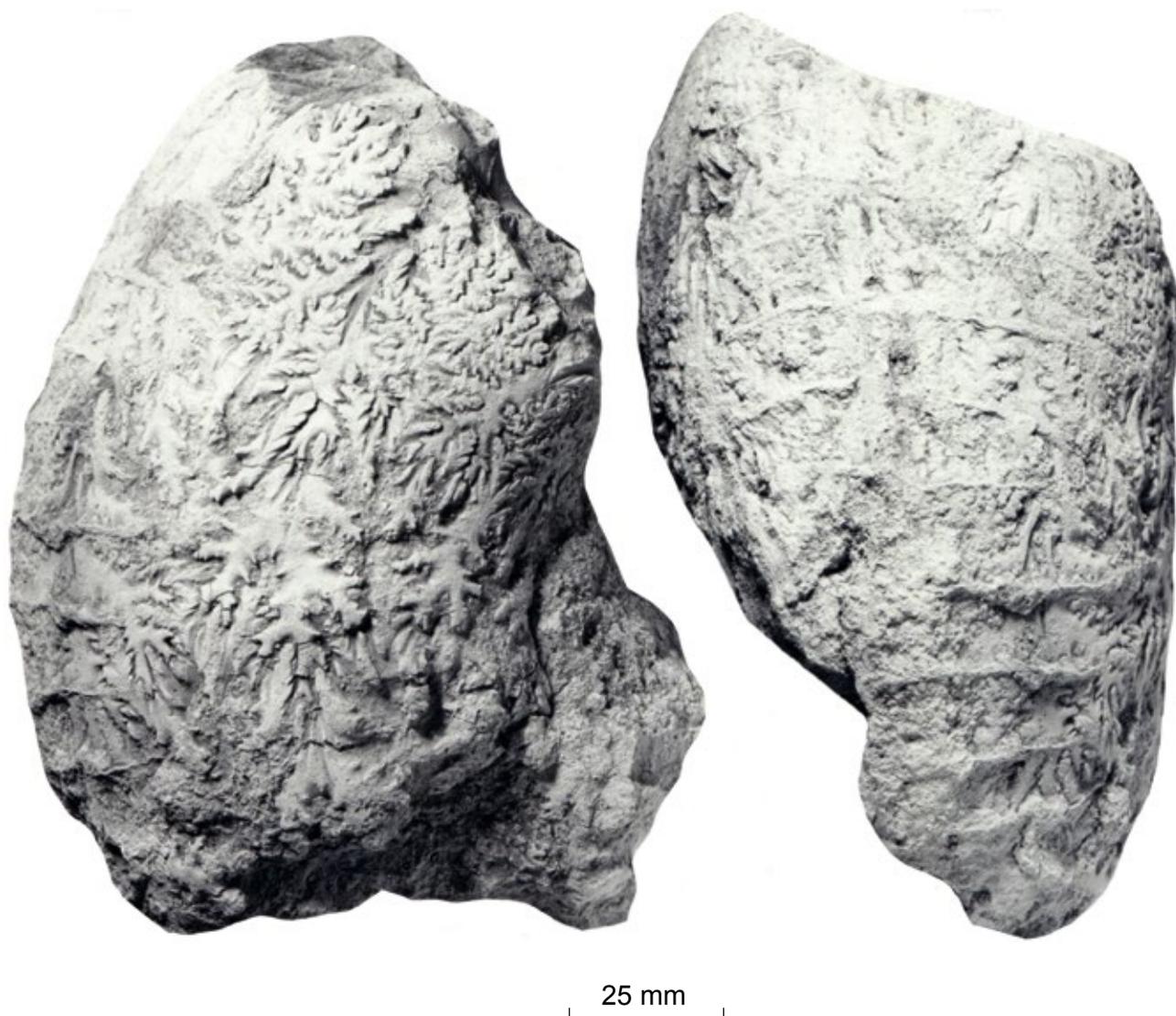


Fig. 8: *Pachydesmoceras* sp. OUM KX1880, from bed 19 of the Fom el Guelta section.

Type Species: *Ammonites latidorsatus* Michelin, 1838, p. 101, pl. 12, fig. 9, by the subsequent designation of Böhm, 1895, p. 364.

Desmoceras* (*Desmoceras*) cf. *latidorsatum

(Michelin, 1838)

Pl. III, fig. 5

Compare:

1838. *Ammonites latidorsatus* Michelin, p. 101, pl. 12, fig. 9.
 1968. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Wiedmann & Dieni, p. 131, pl. 2, figs 2, 6-13, text-fig. 81 (with synonymy).
 1984. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838). – Wright & Kennedy, p. 61, pl. 3, figs 3, 5, 7, 8, 13; text-figs 2b, i.
 1990. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Marcinowski & Wiedmann, p. 62, pl. 7, figs 2, 3 (with synonymy).
 2007. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Kennedy & Latil, p. 458, pl. 2, fig. 1, pl. 6, figs 2, 3, text-fig. 4.
 2007. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Szives, p. 98, pl. 3, fig. 25, pl. 14, fig. 10, pl. 19, figs 3, 4, pl. 26, figs 1, 2, pl. 28, fig. 6.
 2009. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Kennedy & Bilotte, p. 46, pl. 2, figs 6, 7, 19-28, pl. 8, figs 21-23, text-fig. 4.
 2011. *Desmoceras latidorsatum* (Michelin, 1838). – Kennedy *in* Gale *et al.*, p. 75.
 2011. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Klein & Vašiček, p. 144 (with full synonymy).
 2013a. *Desmoceras* (*Desmoceras*) *latidorsatum* (Michelin, 1838).– Kennedy & Klinger, p. 40, figs 1-5.
 2014. (*Desmoceras*) *latidorsatum* (Michelin, 1838). – Kennedy & Fatmi, p. 58, text-figs 11a-h.

Type: The holotype by monotypy, and now lost, is the original of Michelin, 1838, p. 101, pl. 12, fig. 9, from the Albian Gault Clay of Aube, France. Joly *in* Gauthier (2006, p. 97, pl. 3, fig. 1) designated a specimen in the Laboratoire de Paléontologie of the Muséum National d'Histoire Naturelle, Paris, no. B46095, *ex* d'Orbigny Collection 5773-B1, neotype. It is from the condensed Albian of Escragnoles, Var, France.

Material: OUM KX4085-6, from beds 3, Foul el Guelta.

Description and Discussion: These tiny limonitic nuclei have involute coiling, a small umbilicus, slightly compressed whorl section, feebly convex subparallel flanks, broadly rounded ventrolateral shoulders and a convex venter. There is a faint indication of a convex constriction on the venter. The specimens compare well with forma *complanata* of Jacob [1908, p. 38, pl. 14 (4), fig. 10, pl. 15(5), fig. 2; see for example Wiedmann & Dieni, 1968, pl. 12, fig. 7].

Occurrence: *Desmoceras* (*D.*) *latidorsatum* ranges from Middle Albian to Upper Cenomanian, with records from southern England, southern France, northern

Spain, southern Germany, Switzerland, Hungary, Serbia, Poland, Sardinia, Ukraine (Crimea), Algeria, Tunisia, Mozambique, Angola, KwaZulu-Natal South Africa, Madagascar, south India, Japan, Mexico and Venezuela.

Superfamily Hoplitoidea H. Douvillé 1890

Family Hoplitidae H. Douvillé 1890

Subfamily Hoplitinae H. Douvillé 1890

Genus *Hyphoplites* Spath, 1922a

Type species: *Ammonites falcatus* Mantell, 1822, p. 117, pl. 21, figs 6, 12, by the original designation of Spath (1922a, p. 110).

***Hyphoplites falcatus aurora* Wright & Wright, 1949**

Pl. III, figs 3, 6, 7, 9

1949. *Hyphoplites falcatus* (Mantell) *aurora* Wright & Wright, p. 485, pl. 29, figs 3, 9, pl. 30, fig. 5.
 1980. *Hyphoplites falcatus* (Mantell).– Thomel, p. 140, fig. 280.
 1984. *Hyphoplites falcatus aurora* Wright & Wright.– Wright & Kennedy, p. 67, pl. 6, figs 10, 12, 15, text-figs 7k, 9b (with synonymy).
 2009. *Hyphoplites falcatus aurora* Wright & Wright, 1949.– Kennedy & Bilotte, p. 50, pl. 3, figs 17-20, 23-27.

Types: The holotype, by original designation, is BMNH C83686, the original of Wright & Wright, 1949, p. 485, pl. 29, fig. 3, from the upper Upper Albian *perinflatum* Zone ammonite bed in the Upper Greensand at White Nothe, Dorset. There are two paratypes, BGS. GSM37189 and SMC B62711, from the lower Lower Cenomanian *mantelli* Zone, *carcitanense* Subzone fauna of the Glauconitic Marl, at and near Ventnor, Isle of Wight.

Material: OUM K 4060-62, 4067-69 from bed 2, 4091-93 and 4118 (collective of 24 specimens) from bed 3 of the Foul el Guelta section, 40-47 m above the base. OUM KX1203, from the lower part of bed 3 south of Sif et Tella.

Description: These tiny limonitic nuclei range up to 13.2 mm in diameter. Coiling is involute, the umbilicus comprising around 20% of the diameter, with a flattened, outward-inclined umbilical wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with whorl breadth to height ratios of as little as 0.6, the flanks flattened and convergent, the ventrolateral shoulders very narrowly rounded, the venter tabulate, with a siphonal groove. Up to 12 small bullae per whorl perch on the umbilical shoulder, and give rise to pairs of prorsiradiate ribs, with occasional long intercalated ribs that give rise to pairs of concave secondary ribs around mid-flank that broaden across the outer flank and link to well-developed oblique ventral clavi. One specimen, OUM KX1203 retains half a whorl of body chamber. Suture moderately incised, with bifid E/A and trifid A.

Discussion: As noted elsewhere (Wright & Kennedy, 1984, p. 66; Kennedy & Bilotte, 2009, p. 51), the sub-

species of *Hyphoplites falcatus* are differentiated on the basis of the relationship between the straight 'haft' and the concave 'blade' of the sickle-shaped ribs. In *H. falcatus falcatus* (see revision in Wright & Kennedy, 1984, p. 66, pl. 6, figs 11, 13, pl. 7, fig. 2, text-figs 7e-g, 9c), ribs are single; in *H. falcatus aurora* the ribs are mostly dichotomous, branching from the inner flank rib at various levels; in *H. falcatus interpolatus* Wright & Wright, 1949 (see revision in Wright & Kennedy, 1984, p. 68, pl. 6, fig. 14, pl. 7, fig. 3, text-figs 8e, 9d) the ribs are split for most of their length, such that sickle 'blades' have more than one haft or may even be split for part of their length.

Occurrence: Upper Upper Albian, *perinflatum* Zone, southern England and Switzerland; lower Lower Cenomanian, *carcitanense* and possibly higher subzones of the lower Lower Cenomanian *mantelli* Zone, southern England, France, Poland, Germany, Mangyshlak Peninsula in Kazakhstan, and Kopet Dag, Turkmenistan. 'Niveau rouge' of the Selva de Bonansa, Huesca Province, northern Spain, and Djebel Mrhila, Central Tunisia.

Family Engonoceratidae Hyatt, 1900

Genus *Neolobites* Fischer, 1882

Type species: *Ammonites vibrayanus* d'Orbigny, 1841, p. 322, pl. 96, figs 1-3, by monotypy.

***Neolobites fourtaui* Pervinquier, 1907**

Pl. II, figs 1-7, Figs 9, 10B-D

1903. *Neolobites* sp.; Pervinquier, p. 76.
 1904. *Neolobites Peroni* Fourtau (*non* Hyatt), p. 253, pl. 1, fig. 2.
 1907. *Neolobites Fourtaui* Pervinquier, p. 209, pl. 8, fig. 2-6, text-figs 78, 79.
 1908. *Neolobites Fourtaui* Fourtau.– Eck, p. 280, figs 8, 9.
 1914. *Neolobites Fourtaui* Fourtau.– Eck, pl. 14, fig. 6.
 1915. *Neolobites Fourtaui* Pervinquier.– Greco, p. 205 (17) pl. 17 (1), figs 2, 3.
 1954. *Neolobites medinensis* Basse, p. 32, figs 1-11.
 1985. *Neolobites* cf. *peroni* Hyatt.– Dominik, pl. 14, fig. 7.
 1992. *Neolobites fourtaui* Pervinquier.– Thomel, pl. 22, fig. 1.
 2005. *Neolobites fourtaui* Pervinquier, 1907.– Wiese & Schulz, p. 940, fig. 8 d, e, f, g (?), i, j, k.

Types: The species is based on "huit à dix fragments, plus ou moins importants" from east of Bou Hanèche, Kef Si Abd El Kebir in Djebel Mrhila, and Oued Hachichina on the Bir Rekeb sheet (Pervinquier, 1907, p. 211). Five fragments were figured by Pervinquier. We have located none of these in the Sorbonne Collections, and refrain from designating a lectotype at this time.

Material: OUM KX1954, from bed 8, OUM KX 2008-11 and 15908 from bed 9, and OUM KX1940, collected loose, Foug el Guelta. OUM KX1402-8, 3185-91, 3119-20, from bed 8; 3232-6 from bed 10 south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	D
OUM KX3119	61.5 (100)	14.7 (23.9)	32.1 (52.2)	0.46	10.7 (17.4)
OUM KX3236	73.3 (100)	18.5 (25.2)	39.1 (53.3)	0.47	-(-)
OUM KX3120	97.4 (100)	- (-)	42.0 (43.1)	-	24.3 (24.9)

Description: The best-preserved phragmocone is OUM KX3119, 61.5 mm in diameter (Pl. II, fig. 4). Coiling is involute, the umbilicus comprising 17.4% of the diameter, shallow, with a low, flattened, outward-inclined wall, the umbilical shoulder narrowly rounded. The whorl section is very compressed, with a whorl breadth to height ratio of 0.46, the greatest breadth below mid-flank, the inner to middle flanks feebly convex, the outer flanks flattened and convergent, the ventrolateral shoulders narrowly rounded, the venter flattened in intercostal section and feebly concave in costal section. Low, broad, blunt bullae, four per half whorl, perch on the umbilical shoulder. They give rise to two or three straight, prorsiradiate, feebly differentiated ribs that flex back, strengthen, and are concave and well-differentiated on the outer flank, where additional ribs intercalate, to give a total of 23 ribs per half whorl at the ventrolateral shoulder, where all ribs link to a sharp clavus, the clavi linked across the venter by a low, broad, transverse rib. The umbilical bullae increase in strength on the adult phragmocone, as with OUM KX3235 (Pl. II, fig. 6), and give rise to single coarse primaries that strengthen into a mid-lateral



Fig. 9: *Neolobites peroni* Pervinquier, 1907, OUM KX15908, from bed 9 of the Foug el Guelta section.

bullae, with two short intercalated ribs between successive primaries. The mid-lateral bulla is not, in contrast, developed in OUM KX3234 (Pl. II, fig. 2). This specimen shows crowding and approximation of the last few septa, and is an incomplete adult retaining a 60° sector of body chamber, with three umbilical bullae and seven ventral clavi, the flank ornament weak. OUM KX3120 (Pl. II, fig. 7) is a 180° sector of adult body chamber with a maximum preserved diameter of 106 mm. The intercostal whorl breadth to height ratio is 0.57, the costal ratio 0.64, with the greatest breadth just below mid-flank. There are four blunt bullae that give rise to a broad rib or a pair of ribs, strengthened into a large, low, blunt mid-lateral bulla on some of the ribs. Additional ribs intercalate on the outer flank, and all link to a blunt ventral clavus. The venter of the body chamber is much broader than that of the phragmocone. OUM KX15908 (Fig. 9) is a 120° sector of body chamber with a maximum preserved whorl height of 44 mm. Six primary ribs arise at small umbilical bullae, and bear well-developed lateral bullae. Ribbing weakens markedly before strengthening on the outer flank, where there are ten ribs that link to strong, oblique clavi. The sutures are well-preserved (Fig. 10B-D); E has a distinctive W shape. There are four entire saddles separated by narrower, entire lobes and two small saddles with minor incisions on the umbilical wall and shoulder.

Discussion: The strong ornament, with umbilical bullae and ventral clavi, together with the development of mid-lateral bullae on the adaperatural part of the phragmocone and adult body chamber of some individuals is distinctive, and distinguishes the species from *N. vibrayeanus* (d'Orbigny, 1841) (see revision in Wiese & Schulz, 2005, p. 933, figs 4a-e, 5a-d, 6a-j, 7a-e, 8a, b, h, 9a, b, d). *Neolobites peroni* Hyatt, 1903 (Pl. III, figs 8, 10, 11, herein) has a quite different pattern of ribbing in the juvenile, and sparse, broad, low inner flank bullae in later growth, as described below. *Neolobites medinensis* Basse, 1954 (p. 32, figs 1-11) is a clear synonym, as indicated by Wiese & Schulze (2005, p. 940).

The adults in the present collection are small, the largest only 105 mm in diameter; we interpret them as microconchs. Pervinquierè (1907, pl. 8, fig. 5) reconstructed fragments of an individual 145 mm in diameter, and Thomel (1992, pl. 22, fig. 1) illustrated an individual 185 mm in diameter; we interpret them as macroconchs.

Occurrence: Where well-dated, the species is lower Middle Cenomanian, *inermè* and *rhotomagense* Zones. The geographic distribution extends from southeastern France to Portugal, Djebel Mrhila in central Tunisia, Tébaga de Médenine in southern Tunisia, and Egypt.

***Neolobites peroni* Hyatt, 1903**

Pl. III, figs 8, 10, 11, Fig. 10A

1889. *Neolobites vibrayeanus* Thomas & Peron, p. 16, pl. 18, figs 1, 2.

1903. *Neolobites peroni* Hyatt, p. 179.

1903. *Neolobites vibrayeanus* d'Orb.–Pervinquierè, p. 67.

1907. *Neolobites Peroni* Hyatt. – Pervinquierè, p. 208, pl. 8, fig. 1.

non 1908. *Neolobites peroni* Hyatt var. *pervinquirei* Eck & Staff, p. 279.

non 1914. *Neolobites peroni* Hyatt var. *pervinquirei* Staff & Eck.–Eck, p. 191, pl. 11, figs 2, 3.

?non 1957. *Neolobites peroni* Hyatt.–Collignon, p. 132.

non 1965. *Neolobites peroni* Hyatt.–Collignon, p. 171, fig. 3.

1977. *Neolobites peroni* Hyatt. – Mojica & Wiedmann, p. 747, pl. (unnumbered), fig. 2, fig. 4.

non 1992. *Neolobites peroni* Hyatt.–Thomel, pl. 33, fig. 2.

2005. *Neolobites peroni* Hyatt, 1903.–Wiese & Schulz, p. 940 (*pars*), non fig. 9c.

Type: The holotype, by monotypy, is in the MNHP collections (Pl. IV, fig. 11), and was said by Thomas & Peron (1889, explanation of pl. 16, figs 1, 2) to be from Djebel Roumana (?), Tunisia.

Material: OUM KX1884-5, from bed 19, Fom el Guelta.

Dimensions:

	D	Wh	Wb	Wb:Wh	U
OUMKX1885	80.0	25.9	45.2	0.57	7.8
	(100)	(32.4)	(56.5)		(9.8)

Description: OUM KX1885 (Pl. III, fig. 8) is a well-preserved phragmocone 80 mm in diameter. Coiling is very involute, the umbilicus comprising 9.8% of the diameter, shallow, with a low, subvertical wall and broadly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.57, the greatest breadth well below mid-flank. The inner flanks are convex, the outer flanks flattened, and converging to sharp ventrolateral shoulders. The venter is relatively broad, and feebly concave. On the adapical half of the outer whorl, four strong, narrow, widely separated primary ribs arise at the umbilical seam, and strengthen across the umbilical wall and shoulder, without developing into an umbilical bulla. They are straight and prorsiradiate, strengthening progressively, and extending to mid-flank, where they flex back, bifurcate, and are concave on the outer flank. Up to three intercalated ribs of varying length separate the successive pairs of secondaries, and are of comparable strength. All ribs link to clavi, perched on the angular ventrolateral shoulder, and aligned parallel to the shoulder. The clavi are connected across the venter by a low, concave rib. There are four low, broad ribs on the adaperatural half whorl that arise at the umbilical seam and strengthen across the umbilical wall, shoulder and inner flank, where they develop into a low, broad inner lateral bulla. The mid-flank region is worn, and ornament obscure, but apparently effaced, before strengthening on the outer flank, where there are numerous crowded concave ribs that link to small clavi, perched on the ventrolateral shoulder. The ornament of the adaperatural half whorl of this specimen matches well

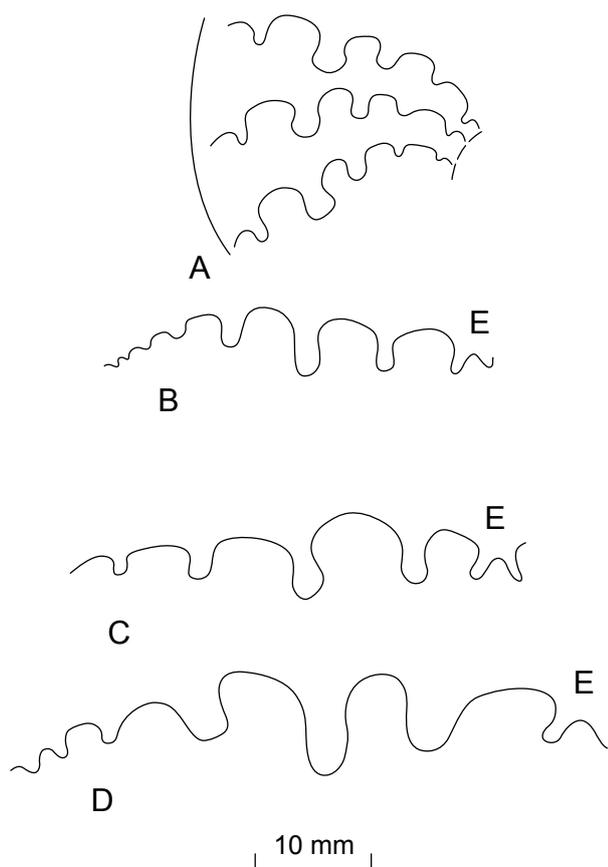


Fig. 10: External suture lines: A: *Neolobites peroni* Hyatt, 1903, OUM KX1885. B-D, *Neolobites fourtaui* Pervinquier, 1907. B, OUM KX3119; C, OUM KX3236; C, OUM KX3235.

with the much larger holotype (Pl. III, fig. 11) a worn and corroded individual with an original estimated diameter of 110 mm, retaining an approximately 120° sector of body chamber. There are sparse, low, broad inner lateral swellings, corresponding to the inner lateral tubercles of OUM KX1885, and numerous crowded concave ribs on the outer flank, linking to albeit worn ventral clavi.

OUM KX 1884 (not figured) is a very corroded specimen 96 mm in diameter with the same inner flank ornament as the holotype.

Discussion: In addition to the Tunisian material, there is an unregistered specimen in the Sorbonne collections (Pl. III, fig. 10), labelled as from the “calcaires jaunâtre en plaques... Batna. El Kantara” and “Rte de Batna à Biskra... Coll. Schlumberger Nov 1888” that has the following dimensions:

	Wb	Wh	Wb:Wh	U
At 61.3 (100)	19.7	34.7	0.55	6.6
	(32.1)	(56.6)		(10.8)

The specimen is almost wholly septate, a corroded internal mould in brown dolomitic limestone. The last few septa

crowd and interfere, suggesting it to be an adult. Coiling is very involute, the tiny shallow umbilicus comprising 10.8% of the diameter, the umbilical shoulder rounded. The whorl section is compressed, with a whorl breadth to height ratio of 0.55, the greatest breadth below mid-flank, the inner flanks convex, the outer flanks flattened and convergent, the ventrolateral shoulders sharp, the venter feebly convex. There are four low, broad swellings on the inner flank and an estimated 16 low, broad ribs on the outer flank, across which they flex back to become concave on the outermost flank, where they broaden markedly to leave a near-smooth zone adjacent to the sharp ventrolateral shoulders. The specimens shares many features with the Tunisian material, notably whorl section, coiling, and flank ornament, but lacks ventral clavi. It appears to be a microconch of the species.

Kennedy & Juignet (1981) considered *N. peroni* to be no more than an intraspecific variant of *N. vibrayeanus*, as have some subsequent authors (Amédéo *et al.*, 1996, p. 195). The strong ornament of the present material immediately distinguishes it from the holotype of *vibrayeanus* (Kennedy & Juignet, 1981, fig. 3; in Gauthier, 2006, p. 118, pl. 59, fig. 1), while the branching of ribs in the juvenile and the development of sparse, low, broad inner flank bullae in the adult separate it from *N. fourtaui*. Wiese & Schulze (2005, p. 940) correctly recognised the validity of *vibrayeanus*, *peroni*, and *fourtaui* as separate species, and their conclusions are followed here.

Occurrence: The material from Djebel Mrhila is firmly dated as lower Middle Cenomanian *inermis* Zone. The geographic distribution is: Algeria, Tunisia, and Zaragoza Province, northern Spain.

Superfamily Hoplitoidea H. Douvillé, 1809

Family Placenticeratidae Hyatt, 1900

Genus *Placenticeras* Meek, 1876

Type species: *Ammonites placenta* DeKay, 1828, p. 28, by the original designation of Meek, 1876, p. 462.

***Placenticeras saadense* Thomas & Peron, 1889**

Pl. I, figs 5, 7, 8, Fig. 11

1889. *Placenticeras saadense* Peron, p. 19, pl. 16, figs 3-7.
 1903. *Placenticeras saadense* Thomas & Peron.—Pervinquier, pp. 68, 80.
 1907. *Placenticeras saadense* Thomas & Peron.—Pervinquier, p. 198, text-fig. 76.
 1907. *Placenticeras saadense* Thomas & Peron.—Vredenberg, p. 118.
 1911. *Engonoceras saadense* Peron.—H. Douvillé, p. 318, figs 69, 70.
 1925. *Engonoceras saadense* Thomas & Peron.—Diener, p. 228.
 1940. *Knemiceras* aff. *saadense* Thomas & Peron.—Breistroffer, p. 129 (59).
 1989. *Engonoceras saadense* Thomas & Peron.—Latil, p. 54, pl. 1, figs 1, 2.

?1989. *Hypenoceras* sp.– Latil, p. 54, pl. 1, fig. 4.

2010. *Knemiceras saadense* Peron & Thomas.– Butjor, p. 6.

Types: Thomas & Peron figured two syntypes, from Djebel Meghila, Tunisia. The original of his pl. 14, fig. 3, 4, is MNHP R.52064, illustrated here as Pl. I, fig. 8, and the original of pl. 14, figs 5-7, MNHP R.52073, illustrated here as Pl. I, fig. 7. Thomas & Peron also mentioned fragments from Bou Saada in Algeria, which also rank as syntypes. Breistroffer discussed this species extensively (1940, pp. 130 (59)-131 (61) : “Quoi qu’il en soit, il s’agit d’une forme très voisine de l’espèce du Vraconien sup. [*saadense*] du Cénomani basal... d’Algérie (Bou Saada = local. –type: holotype non fig., Khenchela) et de Tunisie (Dj. Meghila, Dj Roumana, Dj. Mrhila, D. Adira”). The unfigured Algerian material has not been traced, and Latil (1989, p. 54) designated MNHPR52073, the original of Thomas & Peron’s pl. 16, figs 5-7 (Pl. I, fig. 7 herein), neotype.

Material: An unregistered specimen in the Sorbonne Collections, the original of Pervinquière, 1907, text-fig. 76, from the ‘Vraconnien’ of Djebel Mrhila; an associated label gives a more precise locality: Kef et Tella (=Kef Si Abd el Kader herein). OUM KX818, from south of Foum el Guelta, may also belong here.

Description: The specimen is a phragmocone fragment with a maximum preserved whorl height of 66.3 mm and a whorl breadth to height ratio of 0.5. Coiling is very involute, although the umbilical wall is damaged. The inner flanks are feebly convex, the middle and outer flanks converging to very narrowly rounded umbilical shoulders. The venter is very feebly concave. The surface of the mould is smooth. The suture is somewhat corroded, but accurately reconstructed by Pervinquière, whose illustration is reproduced here as Fig. 11. The elements are all moderately incised, with a very shallow E, broad, asymmetrically bifid E/A, and a further eight bifid saddles in the external suture.

OUM KX818 is a corroded fragment with a maximum preserved whorl height of over 80 mm.

Discussion: As will be seen from the synonymy, the generic assignation of *saadense* is disputed. The suture line is the only criterion available to resolve this. It differs from that of the type species of *Engonoceras*, *E. pierdenalis* Von Buch, 1848 (p. 31, pl. 6, fig. 8), and many other species referred to the genus (Hyatt, 1903) where the saddles, E/A apart, are entire, and from that of the type species of *Knemiceras*, *K. syriacum* (Von Buch, 1848, p. 20, pl. 5, figs 1-5; see revision in Kennedy *et al.*, 2009, p. 6, pl. 1, figs 1-8, pl. 2, figs 1-5, 7, pl. 3, figs 1, 2, 4, pl. 4, figs 1, 2, 4-6, pl. 5, figs 1-4; text-figs 4, 5), where the saddles, E/A apart, are commonly entire or with a minor median incision only. There are closer similarities to the suture of early *Placenticer*s (see for example figs 5-7 in Klinger & Kennedy, 1989), to which genus we refer the species.

Occurrence: Pervinquière (1903, p. 68) described

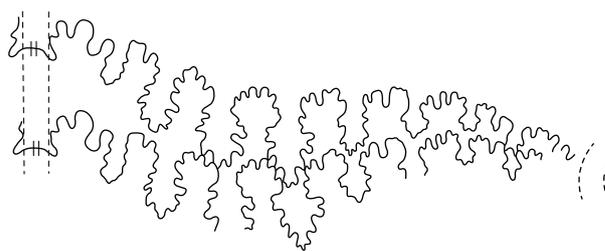


Fig. 11: External suture of *Placenticer saadense* (Thomas & Peron, 1889), based on the original of Pl. III, fig. 5, at a whorl height of 65 mm; copy of Pervinquière, 1907, text-fig. 76. The original specimen is illustrated here as Pl. XII, fig. 7.

the material from Djebel Mrhila as occurring with *Mortoniceras inflatum*; his specimens are described below as *Mortoniceras (Subschloenbachia) perinflatum*, dating the species as upper Upper Albian there. OUM KX818 from south of Foum el Guelta, is associated with *Stoliczkaia* sp. juv (OUM KX819), and *Mariella (M.) bergeri* (see below), again indicating upper Upper Albian. The species is also recorded from Djebel Roumana, and Djebel Adira, Tunisia, and Bou Saad, Khenchela, Algeria. It may also be present in the *perinflatum* Zone of Salzac, Gard, France, according to Latil (1989, p. 56, pl. 1, fig. 4).

Superfamily Acanthoceratoidea De Grossouvre, 1894

Family Brancoceratidae Spath, 1934

Subfamily Mortoniceratinae H. Douvillé, 1912a

Genus *Mortoniceras* Meek, 1876

Type species: *Ammonites vespertinus* Morton, 1834, p. 40, pl. 17, fig. 1, by the original designation of Meek, 1876, p. 448.

Subgenus *Subschloenbachia* Spath, 1921

(= *Durnovarites* Spath, 1932, p. 380;

Reyericeras Collignon, 1979, p. 34).

Type species: *Ammonites rostratus* J. Sowerby, 1817, p. 163, pl. 173, by original designation by Spath, 1921, p. 284.

Mortoniceras (Subschloenbachia) perinflatum

(Spath, 1922a)

Pl. IV, figs 3, 4, 6

1860. *Ammonites inflatus* Pictet & Campiche (*non* J. Sowerby), p. 178, pl. 21, fig. 5, pl. 22, fig. 3.

1903. *Mortoniceras inflatum* Sow.– Pervinquière, p. 66.

1907. *Mortoniceras inflatum* Sowerby.– Pervinquière, p. 229 (*pars*).

1922a. *Inflatoceras (Subschloenbachia) perinflata* Spath, p. 113.

1979. *Mortoniceras (Durnovarites) perinflatum* (Spath, 1922).– Cooper & Kennedy, p. 269, figs 3g, 61, 62d-i, 63, 64 (with synonymy).

2005. *Mortoniceras (Durnovarites) perinflatum* (Spath, 1922).– Kennedy *et al.*, p. 365, text-fig. 10a, 11a-f (with additional synonymy).
2007. *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922).– Kennedy & Latil, p. 465, pl. 3, figs 2, 4, 5 (with additional synonymy).
2011. *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922). – Kennedy in Gale *et al.*, p. 76, text-figs 28a, f, g, 29f.
2011. *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922).– Meister *et al.*, p. 690, text-fig. 5a, b.
2013. *Mortoniceras (Subschloenbachia) cf. perinflatum* (Spath, 1922).– Wilmsen *et al.*, p. 501, text-fig. 7a-c.

Type: The holotype, by monotypy, is the original of Pictet & Campiche, 1860, pl. 22, fig. 3, in the collections of the Muséum d'histoire naturelle, Geneva, from the Upper Albian of La Vraconne, Saint Croix, Switzerland. It was refigured by Renz (1968, pl. 9, fig. 1), Wiedmann & Dieni (1968, pl. 14, fig. 4) and Meister *et al.* (2011, text-fig. 5a, b).

Material: Three unregistered specimens in the Sorbonne Collections, mentioned by Pervinquière [1903, p. 64; 1907, p. 229 (*pars*)], from Fom el Guelta (Pl. IV, fig. 6), and Kef et Tella (= Kef Si Abd el Kader herein) (Pl. IV, figs 3, 4). The specimens are from unit 1 of Pervinquière (1903, text-fig. 14), and were associated with *Stoliczkaiella (S.) dispar* [d'Orbigny, 1841 (Pl. III, fig. 4, pl. IV, fig. 1)].

Description: The smallest specimen (Pl. IV, fig. 4) is a composite internal mould of a phragmocone fragment 40.8 mm long, with a maximum preserved whorl height of 19.3 mm approximately. Worn and distorted, the whorl section appears to have been depressed trapezoidal. Traces of nine ribs survive, predominantly primaries, with umbilical and lateral bullae, strong inner and weaker outer ventrolateral tubercles, the latter giving rise to progressively declining ventral ribs that form an obtuse ventral chevron with a strong siphonal keel at the apex. A larger, worn fragment (Pl. IV, fig. 3) is wholly septate with a maximum preserved whorl height of 43.6 mm, a trapezoidal costal whorl section, the whorl breadth to height ratio 1.15, and an intercostal whorl breadth to height ratio of 1. Primary and long intercalated ribs alternate on the adapical part of the fragment. The adapertural four ribs are all primaries, with umbilical and lateral bullae, inner and outer ventrolateral tubercles, and a strong siphonal keel. The corroded suture has a deeply incised E/A and a broad, bifid A. The largest and best-preserved fragment (Pl. IV, fig. 6) is a 120° sector of phragmocone 133.8 mm long, with a maximum preserved whorl height of 53 mm. Coiling is evolute, the umbilicus deep, the umbilical wall high, flattened, and outward-inclined, the umbilical shoulder broadly rounded. The intercostal whorl breadth to height ratio is 1.07, the greatest breadth below mid-flank, with convex inner to middle flanks, convergent outer flanks, broadly rounded ventrolateral shoulders and a broad, flattened venter. The costal whorl section is polygonal, with a

whorl breadth to height ratio of 1.17, the greatest breadth at the lateral tubercle. Eight primary ribs are present on the fragment. They arise at the umbilical seam and are broad and coarse, projected forwards on the umbilical wall and strengthening into prominent umbilical bullae. On the adapical part of the fragment, these bullae give rise to pairs of narrow, straight ribs that link to weaker lateral bullae, while occasional ribs that also bear lateral bullae intercalate. All ribs strengthen on the outer flank beyond the bullae, sweep forwards and develop into a strong inner ventrolateral tubercle and an outer ventrolateral clavus, the two borne on a single prorsiradiate protuberance, from which the ribs project forwards and efface before reaching the siphonal keel, forming an incomplete obtuse ventral chevron. On the adapertural part of the fragment ribs and tubercles coarsen markedly. The last four ribs are all primaries, coarse on the inner flank between progressively strengthening umbilical and lateral bullae, broadening and weakening on the outer flank and linking to a massive ventrolateral protuberance that bears a rounded-conical inner ventrolateral tubercle and an outer ventrolateral clavus. Broad smooth zones flank the siphonal keel.

Discussion: See Cooper & Kennedy (1979) and Kennedy & Latil (2007).

Occurrence: Upper Upper Albian, index fossil of the *perinflatum* Zone of European workers. The geographic distribution extends from southern England to southeastern France, northern Spain (?), Sardinia, Switzerland, Poland, Hungary, Romania, Crimea, the Lesser Caucasus, Iran, Texas, Tunisia, Nigeria, Angola, and northern KwaZulu-Natal in South Africa.

Genus *Algericeras* Spath, 1925

Type species: *Ammonites boghariensis* Coquand, 1880, p. 32, by the original designation of Spath, 1925, p. 182.

Subgenus *Sakondryella* Collignon, 1964

Type species: *Euhystrioceras (Sakondryella) madagascariense* Collignon 1964, p. 21, pl. 322, figs 1412-1421, by the original designation of Collignon, 1964, p. 21 = *Euhystrioceras remolinense* Böse, 1928, p. 247, pl. 9, figs 13-15.

Algericeras (Sakondryella) remolinense Böse, 1928

Pl. III, fig. 3

1928. *Euhystrioceras remolinense* Böse, p. 247, pl. 9, figs 13-15.
1964. *Euhystrioceras (Sakondryella) madagascariense* Collignon, 1964, p. 21, pl. 322, figs 1412-1421.
1981. *Algericeras (Sakondryella) remolinense* Böse.– Kennedy & Wright, p. 430, pl. 61, figs 1-33, text-fig. 3a-g (with additional synonymy).
1992. *Algericeras (Sakondryella) remolinense* (Böse, 1928).– Atabekian, p. 212, pl. 128, figs 2, 3.

1996. *Algericeras (Sakondryella) remolinense* (Böse, 1928).– Wright, p. 146, text-fig. 112.2a-b.

Type: The holotype, by monotypy, is no. 8226 in the collections of the University of California at Berkeley, from the upper Lower Cenomanian Buda Limestone of El Remolino, 2 km from Rio San Rodrigo in a dry canyon near the road to Oregano, near Jimenez, Coahuila, Mexico. It was refigured by Kennedy & Wright, 1981, pl. 61, figs 1-3.

Material: OUM KX1942, collected loose at the Fom el Guelta section, but by its preservation from the Lower Cenomanian part of the sequence.

Description: The specimen is almost wholly septate, with a maximum preserved diameter of 32 mm. Coiling is evolute, the umbilicus comprising 34% of the diameter, shallow, with a feebly convex wall and broadly rounded umbilical shoulder. The intercostal whorl section is depressed reniform, the costal section has a whorl breadth to height ratio of 1.3-1.4 approximately, the greatest breadth at the umbilical bullae. Ten coarse primary ribs arise at the umbilical seam, and strengthen across the umbilical wall and shoulder, where they develop into strong sharp bullae. These give rise to pairs of ribs, while additional ribs intercalate to give a total of 26-28 at the ventrolateral shoulder. The ribs are straight and prorsiradiate on the inner flank, flexing forwards and feebly concave across the ventrolateral shoulder, where they strengthen into oblique clavi. There is a small, adaperturally displaced siphonal clavus corresponding to the ventral clavi. The ventrolateral and ventral tuberculation becomes less clearly differentiated on the adapertural half whorl, probably an artefact of preservation. The suture is poorly exposed. E/A is broad and bifid, with only minor incisions; A is narrow.

Discussion: The species is comprehensively reviewed by Kennedy & Wright (1981, p. 430).

Occurrence: Lower Cenomanian of Madagascar, Coahuila, Mexico, and central Tunisia.

Family Lyelliceratidae Spath, 1921

Subfamily Stoliczkaeiellinae Breistroffer, 1953

Genus and Subgenus *Stoliczkaeiella* Cooper, 2012

(nom. nov., pro *Stoliczkaia* Neumayr, 1875,
non Jerdon, 1870)

Type species: *Ammonites dispar* d'Orbigny, 1841, p. 142, pl. 45, figs 1, 2, by the original designation of Neumayr, 1875, p. 179.

***Stoliczkaeiella (Stoliczkaeiella) dispar* (d'Orbigny, 1841)**
Pl. III. fig. 4, Pl. IV, fig. 1

1841. *Ammonites dispar* d'Orbigny, p. 142, pl. 45, figs 1, 2.

1903. *Stoliczkaia dispar* d'Orbigny.– Pervinquierè p. 66.

1907. *Stoliczkaia dispar* d'Orbigny.– Pervinquierè, p. 388 (pars), non pl. 12, figs 9, 10, pl. 16, figs 19-23, text-figs 149-151.

1994. *Stoliczkaia (Stoliczkaia) dispar* (d'Orbigny, 1841).– Wright & Kennedy, p. 574, figs 4a-c, 5b, 11h-j, n-p, s-v, 12 a-d, 13d-e (with full synonymy).

1995. *Stoliczkaia dispar* (d'Orbigny, 1840).– Latil, pl. 10, fig. 1.

2002. *Stoliczkaia dispar* (d'Orbigny).– Amédro, pl. 1, fig. 2, pl. 4, fig. 1.

2006. *Stoliczkaia dispar* (d'Orbigny, 1841).– Kennedy & Juignet in Gauthier, p. 49, pl. 48, fig. 1.

2007. *Stoliczkaia (Stoliczkaia) dispar* (d'Orbigny, 1841).– Kennedy & Latil, p. 465, pl. 6, figs 4-6.

Type: The holotype, by monotypy, is the original of d'Orbigny, 1841, pl. 45, figs 1, 2, from Bédoin, south of Mont Ventoux, Vaucluse, France, no. 63927 in the collections of the Département des Sciences et Techniques of Montpellier University. It was figured by Wright & Kennedy (1994, fig. 4) and Kennedy & Juignet in Gauthier (2006, pl. 48, fig. 1).

Material: Two unregistered specimens in the Sorbonne collections, one (Pl. III fig. 4) labelled “Djebel Mrhila, sommet zone inférieur G de la coupe”, the other (Pl. IV, fig. 1) labelled “Fom el Guelta”, and mentioned on p. 391 of Pervinquierè (1907).

Description: The first specimen (Pl. III, fig. 4) is a worn internal mould of a phragmocone fragment with a maximum preserved whorl height of 39.4 mm, and a whorl breadth to height ratio of 0.54. The umbilicus is small, with a feebly convex, outward-inclined wall and broadly rounded umbilical shoulder. The inner flanks are feebly convex, the outer flanks flattened, converging to the broadly rounded ventrolateral shoulders, the venter feebly convex. Primary ribs arise on the umbilical wall and strengthen across the umbilical shoulder, without developing into a bulla. They are straight and prorsiradiate across the flanks, and may bifurcate on the outer flank, whilst additional ribs intercalate around mid-flank. All ribs strengthen across the ventrolateral shoulder, which they pass straight across. A total of 13-14 ribs are present at the ventrolateral shoulders of the fragment. The second specimen (Pl. IV, fig. 1) is an internal mould of a sector of phragmocone with as maximum preserved whorl height of 38.6 mm and a whorl breadth to height ratio of 0.67. Coiling is very involute with a tiny umbilicus of moderate depth, the umbilical wall feebly convex, the ventrolateral shoulders broadly rounded. The inner to middle flank region is feebly convex, the outer flanks flattened and convergent, the ventrolateral shoulders broadly rounded, the venter very feebly convex. Primary ribs arise on the umbilical shoulder and are straight and prorsiradiate on the inner flanks, though rather worn. Some bifurcate, whilst additional ribs intercalate both low and high on the flanks, strengthening across the outermost flank and ventrolateral shoulders, and passing straight across the venter. A total of 14 ribs are present at the ventrolateral shoulder of the fragment.

Discussion: These fragments differ in no significant respects from complete individuals of the same size from southern England (Wright & Kennedy, 1994, text-fig.

12o, p) and southeastern France (Wright & Kennedy, 1994, text-fig. 13d, e).

Occurrence: Upper Upper Albian, *rostratum* and *perinflatum* zones, southern England, southeast France, Switzerland, Germany (?), Hungary, Bulgaria, Turkmenistan, and Central Tunisia.

Subgenus *Lamnayella* Wright & Kennedy, 1978

Type species: *Stoliczkaia (Lamnayella) juigneti* (Wright & Kennedy, 1978), p. 398, pl. 37, figs 1-10, pl. 38, figs 1-12, by the original designation of Wright & Kennedy, 1978, p. 394.

Stoliczkaia (Lamnayella) cf. sanctaecatherinae
(Wright & Kennedy, 1978)

Pl. IV, fig. 5

Compare:

1978. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy, p. 402, pl. 38, figs 13-16, 22, 23, pl. 39, figs 9-11, text-fig. 4a-c.
1984. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Wright & Kennedy, p. 78, pl. 10, figs 12, 14, 15, 16?, text-fig. 11b.
1992. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Atabekian, p. 211, pl. 127, fig. 5, pl. 128, fig. 4.
1994. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Kennedy & Delamette, p. 1274, figs 10.1-10.17; 11.1, 11.21-26, 11.31-39.
1996. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Nishida *et al.*, pl. 17, figs 1, 2.
2004. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Matsumoto *et al.*, p. 77, figs 13-17.
- 2013b. *Stoliczkaia (Lamnayella) sanctaecatherinae* Wright & Kennedy.– Kennedy & Klinger, p. 8, text-figs 16d-f, i-k.

Type: The holotype, by original designation, is BMNH C88579, the original of Wright & Kennedy, 1978, p. 402, pl. 38, figs 13-16, from the Lower Cenomanian *Mantelliceras mantelli* Zone, *Neostlingoceras carcitanense* Subzone fauna of the Glauconitic Marl at Rocken End, Gore Cliff, Isle of Wight. There are three paratypes.

Material: OUM KX1983, from bed 5, Fom el Guelta.

Description: The specimen is 32.4 mm in diameter, and retains extensive areas of recrystallised shell. Coiling appears to have been involute, with a deep umbilicus. The whorl section is depressed reniform, with the greatest breadth at the umbilical bullae. There are an estimated six to seven of these bullae, perched on the umbilical shoulder. They are sharp, and give rise to pairs of ribs, with additional ribs intercalating just outside the umbilical shoulder. The ribs are crowded, strengthen across the flanks, where they are concave, sweeping forwards over the ventrolateral shoulders, and crossing the venter in a pronounced convexity. There are 20 ribs at the ventrolateral shoulder of the outer half whorl.

Discussion: This specimen differs from superficially similar variants of *Mantelliceras lymense* (Pl. VIII, fig. 2) in the strength of the umbilical bullae and the markedly convex course of the ribs on the venter. In these respects it most closely resembles the holotype of *S. (L.) sanctaecatherinae* (Wright & Kennedy, 1984, pl. 10, fig. 15), with which it is compared.

Occurrence: Lower Cenomanian of southern England, Haute-Savoie in France, Kopet Dag in Turkmenistan, Japan, northern KwaZulu-Natal in South Africa, possibly Madagascar, Japan, and Central Tunisia.

Family Forbesciceratidae Wright, 1952

Genus *Forbesciceras* Kossmat, 1897

Type species: *Ammonites largilliertianus* D'Orbigny, 1841, p. 320, pl. 95, by the subsequent designation of Diener, 1925, p. 180.

***Forbesciceras cf. beaumontianum* (d'Orbigny, 1841)**

Pl. I, figs 1, 2, Fig. 12B

Compare:

1841. *Ammonites beaumontianus* d'Orbigny, p. 328, pl. 98, figs 1, 2.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Wright & Kennedy, p. 91, pl. 12, figs 7, 8, pl. 13, fig. 1, text-figs 15a-c, 16a-f (with full synonymy).
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Kennedy & Juignet, p. 147, figs 26d-h, 27i.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Matsumoto, p. 19, fig. 2-2a-d.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Delamette & Kennedy, p. 446, fig. 8.21, 8.22.
1841. *Forbesciceras beaumontianum* (d'Orbigny).– Thomel, pl. 25, fig. 5.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Amédéo in Robaszynski *et al.*, p. 417, pl. 16, figs 20-22.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Kennedy *et al.*, p. 385, text-fig. 10d, e.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Kennedy & Juignet in Gauthier, p. 121, pl. 52, figs 1-3.
1841. *Forbesciceras beaumontianum* (d'Orbigny, 1841).– Kennedy & Klinger, p. 122, text-figs 3a-d, 4a-d, 5.

Types: The lectotype, by the subsequent designation of Wright & Kennedy, 1984, p. 92, is no. 5523 (E 6910) in the collections of the Ecole Nationale supérieure des Mines, now housed in the Université de Lyon-Villeurbanne. It is from the Lower Cenomanian of the route 'de Lamennais à la Ferté-Bernard (Sarthe)' in France; the preservation suggests the lower Lower Cenomanian *Neostlingoceras carcitanense* Subzone of the *Mantelliceras mantelli* Zone. It was refigured by Wright & Kennedy (1984, text-fig. 16a, b), Kennedy & Juignet (1984, text-fig. 26f-h), Kennedy & Juignet in Gauthier (2006, pl. 52, fig. 1), and Kennedy & Klinger (2008, text-fig. 3c, d). A paralectotype, MNHP B4613, illustrated by Kennedy & Juignet (1984, text-fig. 27)

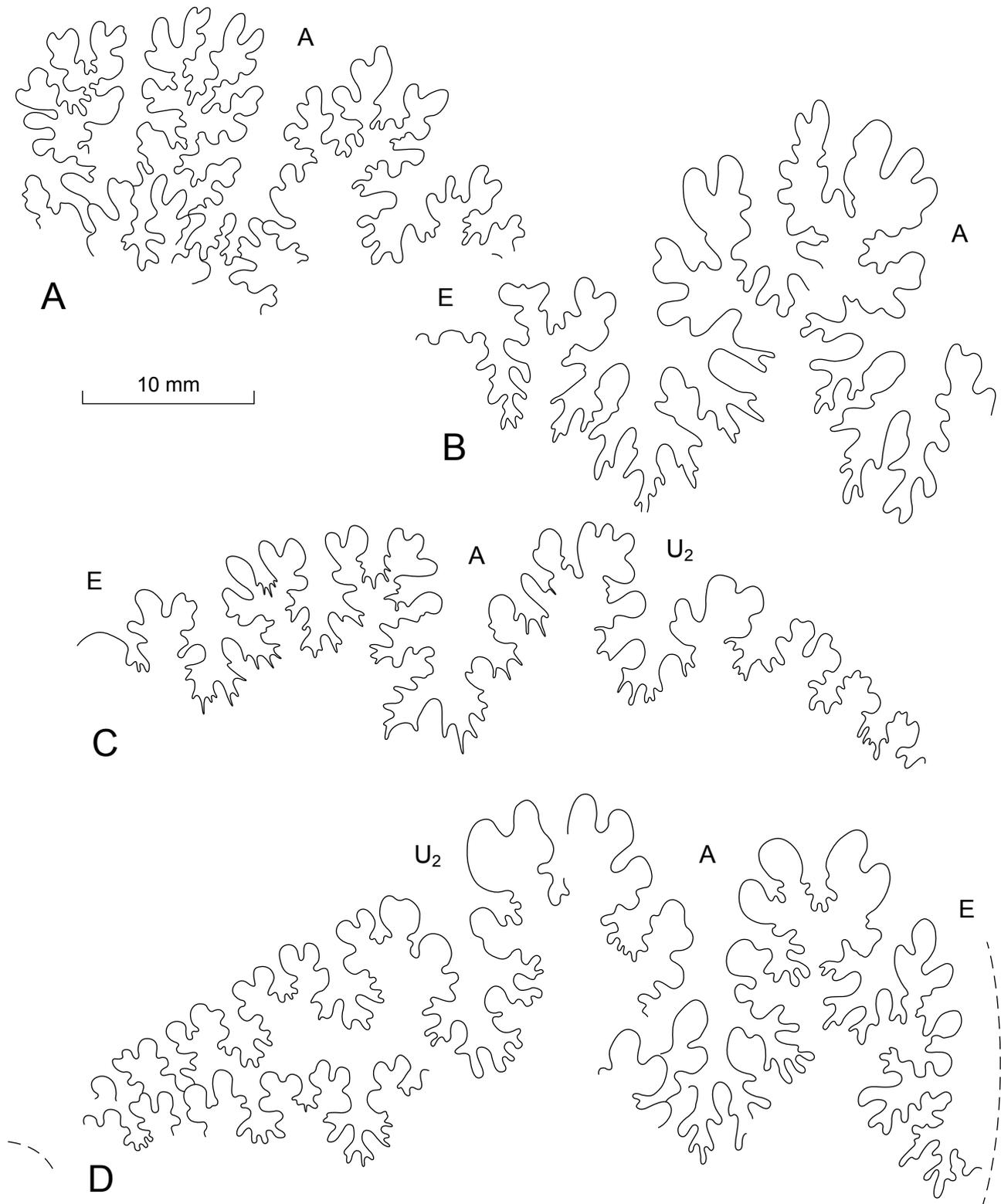


Fig. 12: External suture lines. A, C: *Forbesticeras flicki* Pervinquière, 1907. A: OUM KX3238, C: from the holotype, the original of Pervinquière, 1907, pl. 5, fig. 12 (Pl. V, fig. 3 herein). B: *Forbesticeras cf. beaumontianum* (d'Orbigny, 1841), OUM KX19670. D: *Forbesticeras obiectum* (Sharpe, 1853), the original is a specimen in the Sorbonne Collections, figured here as Pl. I, fig. 9.

and Kennedy & Juignet *in* Gauthier (2006, pl. 52, fig. 3) is in the same preservation as the lectotype. A second paralectotype, MNHP, d'Orbigny Collection, no. 6124, is from Grasse, Var, France, and was figured by Wright & Kennedy (1984, text-fig. 16e, f), and Kennedy & Juignet *in* Gauthier (2006, pl. 52, fig. 2).

Material: OUM KX1970, from bed 5, Fom el Guelta. OUM KX2415, from the base of bed 7 south of Sif et Tella.

Description: OUM KX2415 (Pl. I, fig. 2) is an internal mould of a 90° sector of phragmocone with a maximum preserved whorl height of 34.5 mm. Coiling is very involute, the umbilicus small and shallow, the umbilical wall low, the umbilical shoulder narrowly rounded. The whorl section is very compressed, with a whorl breadth to height ratio of 42% approximately. The inner to middle flanks are very feebly convex and subparallel, the outer flanks converging to the narrow, damaged venter. The inner flanks are smooth. Dense, even, prorsiradiate ribs appear on the outer flank. OUM KX1970 (Pl. I, fig. 1) is a 37.3 mm long fragment of outer flank and venter from the adapical end of the phragmocone preserving a single suture and a very short section of body chamber. The whorl section is compressed, the outer flanks convergent, the ventrolateral shoulders narrowly rounded, the venter feebly fastigiate. The outer flanks are ornamented by narrow, even, crowded, straight, prorsiradiate riblets that link to tiny clavi, perched on the ventrolateral shoulder. The clavi are linked across the venter by single transverse rib. The suture of this specimen (Fig. 12E) shows the bifid, subphylloid E/A with a deep incision and well-developed adventive lobe.

Discussion: These fragments are compared with *Forbesiceras beaumontianum*, rather than *Forbesiceras largilliertianum* (d'Orbigny, 1841) (see revision in Wright & Kennedy, 1984, p. 89, pl. 11, figs 2-6, pl. 12, figs 1-3, 9, pl. 16, fig. 2, text-figs 12a-l, 13a-z, 14a-h) on the basis of the whorl section, and form of the outermost flank and ventral ornament, which closely resembles that of well-preserved English material (Wright & Kennedy, 1984, pl. 13, fig. 1).

Occurrence: Where well dated in western Europe, *F. beaumontianum* characterises the lower Lower Cenomanian *Neostlingoceras carcitense* Subzone of the *Mantelliceras mantelli* Zone, but ranges higher. The geographic distribution is southern England, France, KwaZulu-Natal in South Africa, Madagascar, Japan, Tarrant County, Texas in the USA, and, possibly, Central Tunisia.

***Forbesiceras obtectum* (Sharpe, 1853)**

Pl. I, fig. 9, Pl. V, figs 4, 5, Fig. 12D

1853. *Forbesiceras obtectum* (Sharpe, 1853), p. 20, pl. 7, fig. 4.
 1903. *Forbesiceras largilliertianum* d'Orbigny.– Pervinquier, pp. 66, 69, 78.

1903. *Forbesiceras?* Pervinquier, p. 74.

1907. *Forbesiceras obtectum* Sharpe.– Pervinquier, p. 108, pl. 5, figs 7-11, text-figs 31-34.

1984. *Forbesiceras obtectum* (Sharpe, 1853).– Wright & Kennedy, p. 94, pl. 12, fig. 4, pl. 14, figs 1, 2, pl. 15, fig. 4, text-figs 16g-j, 18 (with full synonymy).

1994. *Forbesiceras obiectum* (Sharpe, 1853).– Amédéo *in* Robaszynski *et al.*, p. 417, pl. 12, fig. 24.

Type: The holotype, by monotypy, is the original of Sharpe, 1853, pl. 7, fig. 4, from the 'chalk with siliceous grains' of Chardstock, Devon. It has not been traced.

Material: The original of Pervinquier, 1907, pl. 5, fig. 11, and a specimen in the Flick Collection, both unregistered, and in the Sorbonne Collections, from Fom el Guelta.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
Perv. pl. 5, fig. 11	106.3	26.4	67.1	0.39	-
	(100)	(24.8)	(63.1)		(-)

Description: The original of Pervinquier's pl. 5, fig. 11 (Pl. V, fig. 4) is a wholly septate internal mould 106.3 mm in diameter, the surface of one flank badly corroded, as is the adapertural part of the figured side. Coiling is very involute, the umbilicus occluded. The whorl section is very compressed, with a whorl breadth to height ratio of 0.39, the greatest breadth below mid-flank. The inner to middle flanks are feebly convex, the outer flanks flattened and convergent. The ventrolateral shoulders are very narrowly rounded, the narrow venter obtusely fastigiate, with a blunt siphonal keel. Ornament is best preserved on the adapical part of the figured flank. Delicate primary ribs arise as mere striae at the umbilicus, and are feebly concave and recti- to feebly prorsiradiate on the inner flank, across which they strengthen progressively, and link to tiny lateral bullae. The ribs flex back from these bullae and are markedly rursiradiate, very feebly concave on the outer flank, across which they strengthen progressively, becoming much more prominent than on the inner flank. They terminate at tiny clavi, perched on the subcarinate ventrolateral shoulder, the shoulder thus appearing crenulate. The siphonal keel bears tiny crenulations, corresponding to the ventral clavi. As size increases, the outer flank ribs become more numerous, increasing by branching at the lateral bullae, and by intercalation. They become weaker and more crowded and change from feebly concave to strongly rursiradiate and feebly convex. The transitional zone between these two types of ornament is corroded. The Flick specimen (Pl. I, fig. 9) is a 120° whorl sector of phragmocone with a maximum preserved whorl height of an estimated 60 mm. Coiling is very involute, with a tiny, shallow umbilicus. The whorl section is very compressed, with a whorl breadth to height ratio of 0.43, the inner to middle flanks feebly convex, the outer flanks flattened and slightly convergent, the outermost flanks converging

more markedly. The ventrolateral shoulders are sharp, subcarinate, the venter obtusely fastigiate, with a median keel. The inner to middle flank region is ornamented by delicate prorsiradiate ribs that arise on the umbilical wall as little more than striae. They branch and flex back, becoming strongly rursiradiate and feebly convex on the outer flank, and increasing by branching and intercalation. In places an incipient mid-lateral bulla is present at the point of initial branching of the ribs. The venter is poorly preserved: there are obscure traces of minute crenulations on the subcarinate ventrolateral shoulders and median keel. The suture of the Flick specimen is well-preserved (Fig. 12D); it is deeply incised, subphylloid, with narrow-stemmed saddles. E/A is bifid with deep median incision producing a large adventive lobe. A is deep and trifid, A/U2 large and asymmetrically bifid, and there are a further five progressively smaller saddles in the external suture.

Discussion: Apart from these well-preserved specimens, there are a number of phragmocone fragments from the Fom el Guelta section that may belong here: OUM KX1914 (Pl. I, fig. 10), KX1915 (Pl. IV, fig. 2) from the lower half of bed 13, and KX1881, from the base of bed 19 (Pl. V, fig. 7). The best preserved of these (Pl. IV, fig. 2) has a maximum preserved whorl height of 80 mm and a whorl breadth to height ratio of 0.45. Fine feebly concave rursiradiate ribs are well-preserved on the inner flank, and there are traces of delicate strongly rursiradiate and feebly concave ribs on the outer flank. The carinate ventrolateral shoulders are minutely crenulated, as is the siphonal keel. Given the preservation, identification as *F. cf. obtectum* is proposed.

Occurrence: The species is lower Middle Cenomanian where well-dated, but may appear already in the Lower Cenomanian; the present specimens, referred to as *F. cf. obtectum* indicate an extension into the lower Upper Cenomanian. The geographic distribution extends from southern England to France, Turkmenistan, Algeria, Tunisia, Lebanon, Algeria, Tunisia, Nigeria and Madagascar.

***Forbesiceras flicki* Pervinquier, 1907**

Pl. V, figs 3, 5, Fig. 12A, C

1903. *Forbesiceras* indét. Pervinquier, p. 67.

1907. *Forbesiceras flicki* Pervinquier, p. 112, pl. 5, fig. 12; fig. b on the plate explanation.

Type: The holotype, by monotypy, is the original of Pervinquier, 1907, pl. 5, fig. 12, from Fom el Guelta, an unregistered specimen collected by Flick and in the Sorbonne Collections.

Material: OUM KX3238, from bed 10 south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
OUM KX3238	80.0	21.9	50.9	0.43	-
	(100)	(27.4)	(63.6)		

Description: The holotype is a 120° whorl sector of the internal mould of a phragmocone with a maximum preserved whorl height of 44 mm, lacking the umbilical margin. The estimated whorl breadth to height ratio is 0.42, the inner to middle flank region feebly and evenly convex, the outer flanks flattened, converging to rounded entire keels that mark the ventrolateral shoulder, the venter fastigiate, and concave on either side of the siphonal keel. Narrow distant, straight, prorsiradiate ribs are present on the inner flanks, and link to the feeblest of mid-lateral tubercles. Pairs of delicate convex to feebly sinuous rursiradiate ribs arise from these bullae, and additional ribs intercalate, the ribs sweeping back, declining and effacing before reaching the ventrolateral keels, which are, as a result, flanked by a smooth outer flank zone. The suture (Fig. 12A, C) is deeply incised, E/A broad and bifid, with a deep median incision. A is relatively broad and asymmetrically bifid, U2 trifid, with five further, progressively smaller saddles in the external suture.

Discussion: *Forbesiceras flicki* differs from *F. obtectum* in the curved, convex course to the ribs, without a marked angulation, much less markedly rursiradiate, the mid-lateral tubercle weaker, the ribs effacing to leave a smooth zone on the outermost flank, the ventrolateral and mid-ventral keels entire, rather than crenulated.

Occurrence: Only known from Central Tunisia, the specimen from south of Sif et Tella is from the lower Middle Cenomanian *inermis* Zone.

***Forbesiceras chevillei* (Pictet & Renevier, 1866)**

Pl. V, figs 1, 2, 6; Fig. 13C

1866. *Ammonites chevillei* Pictet & Renevier, p. 102, pl. 4, fig. 2.
1907. *Forbesiceras sculptum* Crick, p. 182, pl. 11, fig. 7.
1907. *Forbesiceras nodosum* Crick, p. 182, pl. 11, fig. 8.
1964. *Forbesiceras clarki* Collignon, p. 64, pl. 336, fig. 1505.
1984. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Wright & Kennedy, p. 93, pl. 13, fig. 2, pl. 15, figs 1, 2, text-fig. 17 (with full synonymy).
1984. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Kennedy & Juignet, p. 155, fig. 30a-d.
1985. *Forbesiceras sculptum* Crick, 1907.—Immel & Seyed-Emami, p. 97, pl. 3, fig. 4.
- ? 1990. *Forbesiceras cf. chevillei* (Pictet & Renevier, 1866).—Kennedy & Cobban, p. 91, pl. 1, figs 21, 22.
1991. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Delamette & Kennedy, p. 446, fig. 9.1- 9.3.
1995. *Forbesiceras sculptum* Crick.—Colleté *et al.*, pl. X, fig. 4.
1998. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Kaplan *et al.*, p. 112, pl. 1, fig. 6, pl. 9, figs 9, 10, pl. 11, fig. 3.
1998. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Lehmann, p. 19, pl. 2, fig. 6.
2008. *Forbesiceras chevillei* (Pictet & Renevier, 1866).—Kennedy & Klinger, p. 124, pl. 1, figs 1, 6-12, pl. 2, figs 8, 12, 13, text-fig. 6.

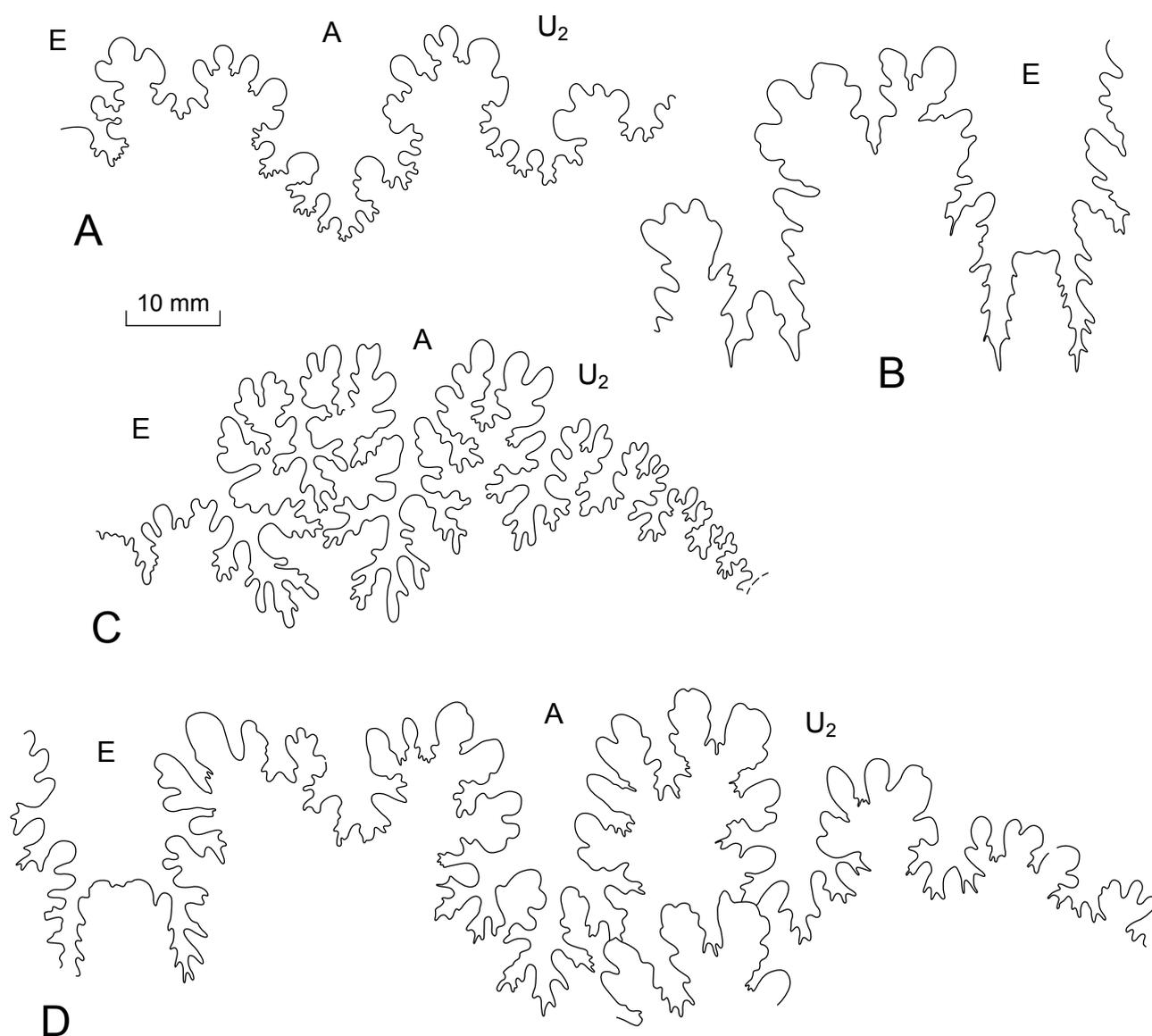


Fig. 13: External suture lines. A, D: *Acompsoceras renevieri* (Sharpe, 1857). A: OUM KX3158; D: OUM KX2026. B: *Calycocheras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897), OUM KX1902. C: *Forbesiceras chevillei* (Pictet & Renevier, 1866), OUM KX2026.

Type: The holotype, by monotypy, of *Forbesiceras chevillei* is the original of Pictet & Renevier, 1866, p. 102, pl. 4, fig. 2, no. 3402 in the collections of the Musée géologique, Lausanne, from the ‘couche moyenne’ at Cheville, Valais, Switzerland. It was refigured by Delamette & Kennedy (1991, fig. 9.1-9.3) and Kennedy & Klinger (2008, text-fig. 6).

Material: OUM KX2034-5 and KX3175-9, from bed 8, Foug el Guelta. OUM KX1396, from bed 8 south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
OUM KX2034	64.4 (100)	15.3 (23.8)	39.8 (61.8)	0.38	4.2 (6.5)

Description: The material comprises phragmocone fragments up to 54 mm in diameter. The best preserved specimen is OUM KX2034 (Pl. V, fig. 6). Coiling is very involute, the tiny, shallow umbilicus comprising 6.5% of the diameter, the umbilical shoulder narrowly rounded, the whorl section very compressed, with a whorl breadth to height ratio of 0.38, the flanks very feebly convex, and subparallel, the ventrolateral shoulders narrowly rounded, the venter very feebly fastigate. The inner flanks bear delicate, distant primary ribs, concave on the inner flank and straight and prorsiradial to mid-flank. There are 12 tiny rounded to feebly bullate mid-lateral tubercles. These give rise to one or two secondary ribs, with additional ribs intercalating to give a total of 26 ribs per half whorl. The ribs are low, feebly concave

and prorsiradiate, broadening progressively across the flanks, with a steep adapical face and a gently inclined adapertural face, and link to well-developed clavi, borne on the ventrolateral shoulder. The interspaces are narrower than the ribs. The clavi are connected across the venter by two or three delicate riblets, with others intercalating between, well-seen in OUM KX3178 (Pl. V, fig. 2b). There is a faint siphonal ridge. Suture (Text-fig. 13C) deeply incised, subphylloid, E/A with a deep incision and resultant adventives lobe, A deep narrow, A/U2 narrow. There are five further saddles in the external suture.

Occurrence: Where well-dated in Western Europe, *Forbesiceras chevillei* ranges from Lower to lower Middle Cenomanian. The geographic distribution is southern England, France, Germany, Switzerland, northern Spain, Turkmenistan, Algeria, Central Tunisia, Nigeria, KwaZulu-Natal in South Africa, Madagascar, and, possibly, Texas.

Family Acanthoceratidae De Grossouvre, 1894

Subfamily Mantelliceratinae Hyatt, 1903

Genus *Mantelliceras* Hyatt, 1903

Type Species: *Ammonites mantelli* J. Sowerby, 1814, p. 199, by the original designation of Hyatt, 1903, p. 113 (ICZN Specific Name No. 1634).

***Mantelliceras mantelli* (J. Sowerby, 1814)**

Pl. VII, fig. 3; Pl. VIII, figs 1, 5

1814. *Ammonites mantelli* J. Sowerby, p. 119, pl. 55, lower figure only.
1984. *Mantelliceras mantelli* (J. Sowerby, 1814).—Wright & Kennedy, p. 99, pl. 16, fig. 5, pl. 17, figs 1, 3, pl. 18, figs 1-3, pl. 19, figs 1-6, pl. 20, figs 1, 2, 4, pl. 21, figs 2, 4, pl. 24, fig. 3, pl. 36, fig. 1, text-figs 20a-d, 26a, c, e, 28a-e (with full synonymy).
1994. *Mantelliceras mantelli* (J. Sowerby, 1814).—Amédéo in Robaszynski *et al.*, p. 407, pl. 12, fig. 16.
1998. *Mantelliceras mantelli* (J. Sowerby, 1814).—Kaplan *et al.*, p. 115, pl. 11, figs 1, 2, pl. 17, figs 12, 13, pl. 19, figs 1-9, pl. 22, figs 3, 4, pl. 23, fig. 8, pl. 24, figs 4-6, pl. 25, figs 1-5 (with additional synonymy).
1998. *Mantelliceras mantelli* (J. Sowerby, 1814).—Lehmann, p. 20, pl. 2, fig. 4.
2002. *Mantelliceras mantelli* (J. Sowerby, 1814).—Amédéo *et al.*, p. 10, pl. 3, fig. 1, pl. 4, fig. 1.
2009. *Mantelliceras mantelli* (J. Sowerby, 1814).—Wilmsen *et al.*, p. 114, text-fig. 3.
2010. *Mantelliceras mantelli* (J. Sowerby, 1814).—Amédéo & Robaszynski, pl. 1, figs 6, 7.
2011. *Mantelliceras mantelli* (J. Sowerby, 1814).—Mosavinia & Wilmsen, p. 178, text-figs 3a-e (with additional synonymy).
2011. *Mantelliceras mantelli* (J. Sowerby, 1814).—Kennedy *et al.*, p. 221, figs 11a-c.
- ? 2013. *Mantelliceras mantelli* (?) Sowerby.—Reboulet *et al.*, text-fig. 4d.
2013. *Mantelliceras mantelli* (J. Sowerby, 1814).—Kennedy *et al.*, p. 634, pl. 2, figs 1-7, pl. 3, figs 1-5.

?2013. *Mantelliceras cf. mantelli* (J. Sowerby, 1814).—Wilmsen *et al.*, p. 504, text-fig. 8f, g.

Type: The lectotype, by the subsequent designation of Kennedy (1971, p. 54), is BMNH 43940a, from the Lower Cenomanian Chalk Marl of Ringmer, near Lewes, Sussex, the original of J. Sowerby (1814, pl. 55, lower figure only), reillustrated by Wright & Kennedy (1984, pl. 18, fig. 3a-c).

Material: OUM KX1924-5, 1927-8, from the base of bed 7, Foum el Guelta. OUM KX2330, from bed 6, and OUM KX2398, 2402 and 2409 from the base of bed 7, south of Sif et Tella.

Description: All of the specimens are rather poorly preserved phragmocones, complete individuals ranging from 33-90 mm in diameter. OUM KX2409 (Pl. VII, fig. 3) is 35.6 mm in diameter. Coiling is moderately evolute, the umbilicus quite deep, and comprising 28% of the diameter, the umbilical wall flattened, the umbilical shoulder broadly rounded. The intercostal whorl section is rounded-rectangular, the costal section polygonal, with the greatest breadth at the lateral tubercle. Nine primary ribs per half whorl arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into small sharp bullae. These give rise to single narrow, straight, prorsiradiate ribs that bear a small sharp, conical mid-lateral tubercle and a subequal inner ventrolateral bulla. A slightly strengthened rib links to an outer ventrolateral tubercle, and passes straight across the venter. Single short ribs intercalate between successive primaries; they bear inner and outer ventrolateral tubercles only, to give a total of 16-17 ribs per half whorl at the ventrolateral shoulder. OUM KX1928 (Pl. VIII, fig. 1) is a more compressed and finer-ribbed variant 33.2 mm in diameter, with 19 ribs per half whorl at the ventrolateral shoulder, and one or two intercalated ribs between successive primaries. OUM KX2398 (Pl. VIII, fig. 5) is the largest specimen referred to *mantelli*, 91 mm in maximum preserved diameter. Coiling is evolute, the umbilicus comprising 28.6% of the diameter, the umbilical wall flattened and subvertical, the umbilical shoulder broadly rounded, the costal whorl section slightly compressed. There are 17 primary ribs on the outer whorl, and a total of 35-36 at the ventrolateral shoulder. Ornament is well-preserved on the adapical half of the outer whorl, the primary ribs with small umbilical bullae, weaker lateral bullae, weak inner and stronger outer ventrolateral tubercles. There are one or two long or short intercalated ribs, with inner and outer ventrolateral tubercles only. The ornament of the adapical half whorl is worn, but ribbing style and tuberculation are similar.

Discussion: The diagnostic features of *Mantelliceras mantelli* are the polygonal costal section, the primary ribs with umbilical, lateral, inner and outer ventrolateral tubercles, the intercalated ribs with inner and outer ventrolateral tubercles. See Wright & Kennedy, 1984 (p. 99) for a comprehensive discussion.

Occurrence: Commonest in the *Mantelliceras mantelli* Zone of the Lower Cenomanian, but extending into the succeeding *Mantelliceras dixonii* Zone. The species ranges from England to Northern Ireland, France, Germany, Russia, Iran, Kazakhstan, North Africa, KwaZulu-Natal in South Africa, Madagascar, southern India, and Japan.

***Mantelliceras cantianum* Spath, 1926a**

Pl. X, fig. 8

- 1926a. *Mantelliceras cantianum* Spath, p. 82.
 1984. *Mantelliceras cantianum* Spath, 1926.– Wright & Kennedy, p. 103, pl. 17, fig. 2, pl. 20, fig. 3, pl. 21, fig. 3, pl. 24, figs 1, 2, 4-6, pl. 25, figs 1-6, pl. 26, figs 1, 2, 4, 5, pl. 38, fig. 1, text-figs 25a; 27e-h, j-l (with full synonymy).
 1998. *Mantelliceras cantianum* Spath, 1926a.– Kaplan *et al.*, p. 116, pl. 18, figs 5, 6, 10, 11, pl. 20, figs 2, 3, pl. 21, figs 1-3, pl. 26, fig. 6 (with additional synonymy).
 ? 1998. *Mantelliceras cf. cantianum* (Spath, 1926).– Lehmann, p. 21, pl. 3, fig. 4.
 2002. *Mantelliceras cantianum* Spath, 1926.– Amédéo *et al.*, p. 10, pl. 3, fig. 3, pl. 4, fig. 2.
 2010. *Mantelliceras cantianum* Spath, 1926.– Amédéo & Robaszynski, pl. 1, fig. 8.
 2011. *Mantelliceras cantianum* Spath, 1926. – Mosavina & Wilmsen, p. 180, text-figs 4a, b, h (with additional synonymy).
 2013. *Mantelliceras cantianum* Spath, 1926a.– Kennedy *et al.*, p. 635, text-fig. 4e, f.

Types: The holotype, by original designation, is BMNH 36834, from the Lower Cenomanian Chalk Marl of Dover, Kent; paratype BMNH C5027 is from the same unit at Lewes, Sussex. They were figured by Sharpe (1857, pl. 18, figs 1, 2) and Wright & Kennedy (1984, pl. 24, figs 2, 6).

Material: OUM KX1929, from the base of bed 7, Fom el Guelta.

Description: OUM KX1929 (Pl. X, fig. 8) is a 90° whorl fragment with a maximum preserved whorl height of 32.4 mm and a costal whorl to breadth to height ratio of 0.96. There are five primary ribs on the fragment, with one or two intercalated ribs between successive primaries. The primary ribs are broad and coarse on the umbilical wall, strengthening into bullae, perched on the umbilical shoulder. These give rise to a strong, straight, rectiradiate rib that bears a lateral bulla, weak on the adapical part of the fragment, but coarsening and becoming prominent on the four adapertural primaries. One or two long or short intercalated ribs separate successive primaries, all ribs strengthening on the outer flank, and linking to strong outer ventrolateral clavi, linked over the venter by a broad, transverse rib. Suture moderately incised, with a broad bifid E/A and narrow, bifid A.

Discussion: The distinctive features of *Mantelliceras cantianum* are the depressed whorl section, broadening through ontogeny, primary ribs with strong umbilical and stronger inner lateral tubercles, inner ventrolateral tubercles on primary and intercalated ribs that are

commonly lost early in ontogeny, and outer ventrolateral clavi that are also commonly lost in the later ontogenetic stages.

Occurrence: Lower Cenomanian, *Mantelliceras mantelli* and *M. dixonii* Zones. The geographic distribution extends from southern England across France, northern Spain, Germany, Switzerland, Romania (?), Iran, Central Tunisia, KwaZulu-Natal in South Africa, Madagascar, and Japan.

***Mantelliceras lymense* (Spath, 1926b)**

Pl. III, fig. 1; Pl. VII, figs 1, 6; Pl. VIII, figs 2, 6; Pl. XXIII, fig. 2; Text-fig. 14

- 1926b. *Eucalycoceras lymense* Spath, pp. 427, 431.
 1984. *Mantelliceras lymense* (Spath, 1926).– Wright & Kennedy, p. 102, pl. 10, fig. 9, pl. 22, figs 1-6, pl. 23, figs 1-3, pl. 31, figs 1, 2, pl. 36, fig. 4, text-figs 19, 24a, b, 26d, 28f-j (with full synonymy).
 2004. *Mantelliceras lymense* (Spath, 1926).– Amédéo in Robaszynski *et al.*, p. 406, pl. 10, figs 1, 2.
 2011. *Mantelliceras lymense* (Spath, 1926).– Mosavina & Wilmsen, p. 182, text-figs 4d, e (with additional synonymy).

Type: The lectotype, by the subsequent designation of Wright & Kennedy, 1984, p. 102, is the original of Pervinquière, 1907, pl. 16, fig. 16, refigured by Wright & Kennedy, 1984, text-fig. 24a, b, from south of Bargou, Tunisia, an unregistered specimen in the collections of the Ecole des Mines, Paris, currently housed in the collections of the Université de Lyon-Villeurbanne.

Material: OUM KX1973-5, from bed 5, OUM KX 1921 and 1926, from the base of bed 7, Fom el Guelta. OUM KX824-5, 1189, 1190-91, from bed 5, south of Sif et Tella. MNHPR52344-5, from Djebel Mrhila, without precise locality. An unregistered specimen collected by Pervinquière in the Sorbonne Collections, from Kef et Tella (Kef Si Abd el Kader).

Dimensions:

	D	Wb	Wh	Wb:Wh	U
Pl. VIII, fig. 1 c	63.8 (100)	31.0 (48.6)	28.6 (40.7)	1.1	12.4 (19.4)
OUM KX1192 c	94.4 (100)	36.8 (39.0)	46.9 (49.7)	0.78	26.1 (27.6)

Description: OUM KX1921 (Pl. VIII, fig. 2) is a well-preserved half whorl of a juvenile phragmocone with a maximum preserved diameter of 39 mm. Coiling is moderately involute, the umbilical wall feebly convex, the umbilical shoulder broadly rounded. The whorl section is slightly depressed reniform, with the maximum breadth below mid-flank. The ribs arise at the umbilical seam, strengthen across the umbilical wall and shoulder, without developing into a significant bulla. The ribs are near-straight across the flanks, where one or two ribs intercalate, to give a total of an estimated 24-26 ribs per half whorl at the ventrolateral shoulder.



Fig. 14: *Mantelliceras lymense* (Spath, 1926b), MNHP R52346, from Djebel Mrhila.

The ribs strengthen slightly across the ventrolateral shoulders, and pass straight across the venter, without developing tubercles. One of Pervinquière's specimens (Pl. VII, fig. 1), labelled *Ac. cf. newboldi*, is 63.8 mm in diameter, and retains a 120° sector of body chamber. The umbilicus comprises 19.4% of the diameter, the umbilicus of moderate depth, with a flattened wall and broadly rounded umbilical shoulder. The intercostal whorl section is oval, with feebly convex flanks, broadly rounded ventrolateral shoulders, and a broad, feebly convex venter. The costal section is rounded-feebly trapezoidal, with a whorl breadth to height ratio of 1.1. There are an estimated 22 primary ribs on the outer whorl. They arise at the umbilical seam, and are straight and prorsiradiate across the inner and middle flanks; additional single ribs intercalate low on the flanks, the ribs strengthening progressively, flexing forwards and

feebly concave across the ventrolateral shoulders, where there are 22 ribs on the adapertural half whorl of the specimen. All ribs bear small ventral clavi, linked across the venter by a strong transverse to feebly convex rib. OUM KX1192 (Pl. VII, fig. 6) retains a 180° sector of body chamber, and may be an incomplete adult; it has a maximum preserved diameter of 97 mm, the umbilicus comprising 27.6% of the diameter (a figure increased by *post-mortem* deformation). This is a more compressed individual, with a whorl breadth to height ratio of 0.78. There are 11 primary ribs on the adapertural half whorl, and 22 at the ventrolateral shoulder. The primary ribs bear weak bullae that strengthen around the outer whorl, and are separated by single long intercalated ribs. The ribs pass straight across the flanks, strengthening progressively, and linking to feeble ventral clavi, linked across the venter by a relatively coarse transverse to

feebly convex rib. MNHP R52345 (Pl. VIII, fig. 6) has a crushed nucleus, and retains the adapical end of an adult body chamber with a maximum preserved whorl height of 43 mm, the whorl section slightly compressed in costal section. Bullate primary and single intercalated ribs alternate regularly, the intercalated ribs in some cases feebly linked to an umbilical bulla. All ribs have a pronounced ventrolateral angulation, and a progressively weakening ventral tubercle. MNHP R52346 (Text-fig. 14) is a near-complete adult macroconch body chamber 150 mm in diameter, with a maximum preserved whorl height of 72.5 mm, and a whorl breadth to height ratio of 0.97. Eighteen ribs are preserved on the half whorl of body chamber. Strong, narrow, distant primary ribs arise at the umbilical seam and strengthen markedly across the umbilical wall and shoulder, where they develop into high, strong umbilical bullae at the adapical end of the fragment; these decline and efface towards the adapertural end of the fragment. The ribs are feebly prorsiradiate and straight on the inner flanks, flexing back and retroradiate on the outer flank, and transverse over the venter. The single intercalated ribs arise low on the flanks and strengthen to match primary ribs on the ventrolateral shoulders and venter. All ribs bear well-developed ventral clavi at the adapical end of the body chamber, which rapidly efface, their site marked by an angulation on all but the four adapertural most ribs, where the venter rounds. The suture is moderately incised, with a broad bifid E/A and narrower bifid A.

An unregistered specimen in the Sorbonne Collections (ex Flick Collection: Pl. XXIII, fig. 2) is in part body chamber, and 81 mm in diameter. Coiling is moderately involute, with 72% of the previous whorl covered. The whorl section has been distorted by *post-mortem* deformation, but appears originally to have been depressed, with convex flanks and a broad feebly flattened to feebly convex venter. There are nine to ten primary ribs on the adapertural half of the outer whorl; they arise at the umbilical seam, strengthen across the umbilical wall and develop into well-developed bullae, perched on the umbilical shoulder. The bullae give rise to pairs of ribs, and additional long ribs intercalate, to give a total of 18-20 ribs at the ventrolateral shoulder of the outer whorl. The ribs are feebly convex on the adapical half of the outer whorl, straight on the adapertural half, and feebly rursiradiate, strengthening across the flanks, and linking to small ventrolateral tubercles, in turn linked over the venter by a strong, transverse rib. The ornament on the adapical half whorl of this specimen is quite unlike that seen on other specimens referred to *M. lymense*; it appears to be either a pathological condition, or a result of *post-mortem* deformation.

Discussion: The diagnostic features of *Mantelliceras lymense* are the rounded whorl section, primary ribs with umbilical bullae and outer ventrolateral clavi, and intercalated ribs with outer ventrolateral clavi only whilst in some individuals the outer ventrolateral clavi are lost

for part of the ontogeny (Pl. VIII, fig. 2). Others have a weak indication of an inner ventrolateral tubercle, but these are soon lost. See Wright & Kennedy (1984, p. 102) for a comprehensive discussion.

Occurrence: Lower Cenomanian, *Mantelliceras mantelli* and *Mantelliceras dixonii* Zones, southern England, Northern Ireland, France from the Boulonnais south to Bouches-du-Rhône, Algeria, Central Tunisia, Madagascar, and possibly Germany and Iran.

Mantelliceras saxbii (Sharpe, 1857)

Pl. VII, figs 4, Pl. VIII, fig. 4

1857. *Ammonites Saxbii* Sharpe, p. 45, pl. 20, fig. 3.
 1984. *Mantelliceras saxbii* (Sharpe, 1857).– Wright & Kennedy, p. 121, pl. 23, fig. 4, pl. 32, figs 1-3, pl. 33, figs 1-4, pl. 34, figs 1-4, pl. 35, figs 1-5, pl. 36, figs 2, 3, pl. 39, fig. 1, text-figs 25b-d, i, 26b, 281-p (with full synonymy).
 1998. *Mantelliceras saxbii* (Sharpe, 1857).– Kaplan *et al.*, p. 118, pl. 18, figs 1, 9, pl. 20, fig. 1, pl. 24, fig. 3, pl. 26, figs 7, 8, pl. 41, figs 2, 4 (with additional synonymy).
 1998. *Mantelliceras saxbii* (Sharpe, 1857).– Lehmann, p. 21, pl. 2, fig. 6.
 ?2003. *Mantelliceras saxbii* (Sharpe).– Kawabe *et al.*, pl. 2, fig. 1.
 2004. *Mantelliceras saxbii* (Sharpe, 1857).– Amédro in Robaszynski *et al.*, p. 407, pl. 12, figs 17, 18.
 ?2005. *Mantelliceras saxbii* (Sharpe, 1857).– Aly *et al.*, p. 370, pl. 7, fig. 2 only, non 3.
 2011. *Mantelliceras saxbii* (Sharpe, 1857).– Mosavinia & Wilmsen, p. 182, text-fig. 4c, f, g (with additional synonymy).
 2013. *Mantelliceras saxbii* (Sharpe, 1857).– Wilmsen *et al.*, p. 502; text-fig. 8.
 2013. *Mantelliceras saxbii* (Sharpe, 1857).– Kennedy *et al.*, p. 637, pl. 4, figs 3-6, text-fig. 4c, d, g.
 2014. *Mantelliceras saxbii* (Sharpe, 1857).– Walaszczyk *et al.*, p. 110, fig. 24h.

Lectotype: No. 7763 in the collections of the British Geological Survey, the original of Sharpe 1857, pl. 20, fig. 3, by the subsequence designation of Wright & Wright 1951, p. 38. It was refigured by Wright & Kennedy (1984, pl. 35, fig. 2), and is from the Lower Cenomanian “Grey Chalk of Ventnor”, Isle of Wight, U.K.

Material: OUM KX1194-5, from the lower part of bed 5 south of Sif et Tella. There are two unregistered Pervinière specimens in the Sorbonne Collections, the smaller (Pl. VII, fig. 4) from Kef et Tella (Kef Si Abd el Kader), the larger (Pl. VIII, fig. 5), from Kef Si Abd El Kader.

Description: The smaller Pervinière specimen (Pl. VII, fig. 4; labelled Acanth. Mantelli ou Martimpreyi) is a wholly septate 120° whorl sector with a maximum preserved whorl height of 25.1 mm. The whorl section is compressed, with a whorl breadth to height ratio of 0.92. The inner to mid-flank region is feebly convex, the outer flanks convergent, the ventrolateral shoulders broadly rounded, the venter flattened. Primary ribs

arise on the umbilical wall and strengthen into small umbilical bullae, from which ribs arise either singly or in pairs. They are straight and prorsiradiate on the inner flank, feebly convex at mid-flank, and feebly concave and strengthened on the outer flank. Some of these ribs bifurcate, and there are additional intercalated ribs. All ribs bear small ventral clavi, connected across the venter by a low, broad, transverse rib. The larger Pervinquièrè specimen [Pl. VIII, fig. 4; labelled *Ac. couloni* d'Orb. (= *mantelli* var. *plat*)] is a just under 180° whorl sector, mostly adult phragmocone with a short, partly crushed section of body chamber. The maximum preserved whorl height is 50 mm, the intercostal whorl breadth to height ratio 0.78, the costal whorl breadth to height ratio 0.87. The flanks are feebly convex, the ventrolateral shoulders broadly rounded, the venter flattened in intercostal section. A fragment of the penultimate whorl is preserved, with fine, crowded ribbing. There are seven primary ribs on the outer whorl fragment. They arise on the umbilical wall, and strengthen into elongate blunt bullae. These give rise to single ribs, coarse and straight on the inner to mid-flank, and very feebly concave on the outer flank. They alternate with single intercalated ribs that arise around mid-flank. All ribs broaden and coarsen on the outer flank and ventrolateral shoulder, and bear blunt rounded-clavate ventral tubercles, linked across the venter by a low, broad transverse rib. The suture is quite deeply incised, with a broad bifid E/A, narrower A with long median element, and smaller, bifid U2.

Discussion: *Mantelliceras saxbii* is characterised by rather involute coiling in early and middle growth, where the whorl section is compressed, the ribs more or less flexuous with up to four intercalated ribs between successive primaries. The primary ribs bear weak umbilical bullae; small lateral tubercles may be present in middle growth. All ribs bear weak inner and stronger clavate outer ventrolateral tubercles; the former commonly disappear on or before the adult body chamber, the latter disappearing on the adapertural half of the adult body chamber. See discussion in Wright & Kennedy, 1984 (p. 122).

Occurrence: *Mantelliceras saxbii* ranges throughout the Lower Cenomanian, but is common only in the middle of the Substage, being represented by rather stout forms in the lower part of its range and by densely and flexuously ribbed forms in the upper part. It is widespread in southern England, the Boulonnais, Haute Normandie, Maine, Sarthe and Provence in France, northern Spain, Switzerland, Poland, Romania, Bulgaria, Kazakhstan, Iran north of the Zagros, Morocco, Algeria, Tunisia, Angola, KwaZulu-Natal in South Africa, Madagascar, and Japan.

***Mantelliceras couloni* (d'Orbigny, 1850)**

Pl. VII, figs 2, 5, Pl. VIII, fig. 3

1841. *Ammonites Mantelli* Sowerby.– d'Orbigny, p. 340 [pars], pl. 104, figs 1-4.

1850. *Ammonites Couloni* d'Orbigny, p. 147.
 1984. *Mantelliceras couloni* (d'Orbigny, 1850).– Wright & Kennedy, p. 119, pl. 21, fig. 1, pl. 23, figs 5, 6, pl. 29, figs 1-3, pl. 30, figs 1, 2, pl. 31, figs 3-5, pl. 36, fig. 5, text-figs 25f, h, 27a-d (with full synonymy).
 1991. *Mantelliceras cf. couloni* (d'Orbigny, 1850).– Matsu-moto & Toshimitsu, p. 2, pl. 1, figs a-e.
 1996. *Mantelliceras couloni* (d'Orbigny, 1850).– Kennedy in Gale *et al.*, p. 563, text-figs 15a, 19k.
 1997a. *Mantelliceras couloni* (d'Orbigny).– Wilmsen, pl. 23, fig. 4.
 2005. *Mantelliceras cf. couloni* (d'Orbigny, 1850).– Matsu-moto & Toshimitsu, p. 31, figs 1a, b.
 2006. *Mantelliceras couloni* (d'Orbigny, 1850).– Kennedy & Juignet in Gauthier, p. 125, pl. 51, figs 1-3.

Type: The lectotype, by the subsequent designation of Juignet & Kennedy (1976, p. 95) is no. R8011 (formerly 1896-27) in the collections of the Laboratoire de Paléontologie of the Muséum National d'Histoire Naturelle, Paris, and from the Lower Cenomanian of Lamnay, Sarthe, France. It was refigured by, amongst others, Wright & Kennedy (1984, text-fig. 20G-I) and Kennedy & Juignet in Gauthier (2006, pl. 51, fig. 1).

Material: OUM KX1961, from bed 3, Foug el Guelta. OUM KX1051-2 and 1067, from bed 5 south of Sif et Tella.

Description: OUM KX1067 (Pl. VII, fig. 5) is a well-preserved internal mould of a phragmocone 62 mm in diameter, and a 90° sector of crushed body chamber. The maximum preserved diameter 78 mm. Coiling is moderately involute, with 54% of the previous whorl covered, the umbilicus shallow, and comprising 23% of the diameter, the umbilical wall flattened, the umbilical shoulder broadly rounded. The whorl section is compressed, the flanks feebly convex, subparallel, the ventrolateral shoulders broadly rounded, the venter very feebly convex. The costal whorl breadth to height ratio is 0.86, the greatest breadth at the umbilical bullae. On the phragmocone, 17 to 18 ribs arise at the umbilical seam, and strengthen across the umbilical wall and shoulder, where they develop into feeble bullae of variable strength. One or two intercalated ribs arise below mid-flank. The ribs broaden across the flanks, and are straight and prorsiradiate on the inner to mid-flank, where they flex back slightly, and cross the ventrolateral shoulders in the slightest of concavities, and link to a weak, feebly clavate ventrolateral tubercle, the tubercles linked across the venter by a low, broad, transverse rib. On the body chamber, the ribs are predominantly primaries, one of which bifurcates low on the flank, stronger than on the phragmocone, and strengthening into much stronger ventrolateral tubercles, linked across the venter by a strong, high rib. OUM KX1052 (Pl. VII, fig. 2) is a crushed phragmocone fragment with a maximum preserved whorl height of 37.5 mm. Strong primary and long intercalated ribs alternate regularly, the primaries with well-developed umbilical bullae. All ribs bear

strong ventrolateral clavi. OUM KX1961 (Pl. VIII, fig. 3) is a stouter individual (the stoutness in part enhanced by *post-mortem* distortion), and shows strong ventrolateral tubercles, the venter markedly concave between in costal section. The suture of OUM KX1067 is moderately incised, with a broad, bifid E/A and narrow A.

Discussion: *Mantelliceras couloni* is characterised by involute coiling, compressed whorl section, and numerous flexuous ribs, branching from feeble umbilical bullae or intercalating, all ribs with inner ventrolateral bullae and outer ventrolateral clavi, the former weakening and effacing through ontogeny, the latter strengthening markedly, the intercostal rib profile deeply sulcate between, before weakening on the adult body chamber. See Wright & Kennedy, 1984 (p. 119) for discussion.

Occurrence: Lower Cenomanian, southern England, northwestern and southeastern France, Iran, Romania (?), Central Tunisia, Japan, and northern KwaZulu-Natal in South Africa.

Genus *Graysonites* Young, 1958

Type species: *Graysonites lozoi* Young, 1958, p. 172, pl. 27, figs 1-11, text-fig 1b, c, d, f, by original designation = *Mantelliceras wacoense* Böse, 1928, p. 215, pl. 5, figs 9-25, pl. 6, figs 1-4.

Name of the type species of *Graysonites*: Kennedy (in Kennedy *et al.*, 2005, p. 386) demonstrated that *Mantelliceras wacoense* Böse, 1928, *Mantelliceras brazoense* Böse, 1928, *Graysonites lozoi* Young, 1958, and *Graysonites wooldridgei* Young, 1958, were conspecific, and selected the name *wacoense* Böse, 1928, for the species.

Graysonites cherbensis (Thomas & Péron, 1889)

Pl. IX, figs 1-12, Figs 15, 16

1889. *Hoplites cherbensis* Thomas & Péron, p. 31, pl. 17, figs 4, 5.
 1907. *Acanthoceras suzannae* Pervinquier, p. 298, pl. 16, figs 12-13.
 1907. *Sharpeiceras laticlavium* Sharpe var. *byzacenica* Pervinquier, pp. 302, 419, pl. 14, fig. 4.
 1907. *Hoplites cherbensis* Thomas & Peron.– Pervinquier, pp. 187, 422.
 1985. *Graysonites byzacenica* (Pervinquier, 1907).– Howarth, p. 91.
 1987. *Acanthoceras laticlavium* var. *byzacenica* Pervinquier.– Wright & Kennedy, p. 128, text-fig. 35b, c.

Type: The holotype, by monotypy, is the original *Hoplites cherbensis* Thomas & Péron, 1889, p. 31, pl. 17, figs 4, 5 (Pl. IX, fig. 7 herein), from Bir Mageur, Djebel Cherb, Tunisia, housed in the collections of the Laboratoire de Paléontologie of the Muséum National d'Histoire Naturelle, Paris, no. F-R52077.

Material: OUM KX 4054-5, from 23-28 m above the base of bed 2, and OUM KX4108-9, from bed 3, Fom

el Guelta. MNHP R52350a-b, from the Cenomanian of Djebel Mrhila.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
Holotype	75.5 (100)	28.3 (37.5)	31.2 (41.3)	0.91	21.8 (28.9)

Description: The holotype is heavily corroded. Coiling is moderately evolute, the umbilicus shallow, comprising 28.9% of the diameter. The umbilical wall is vertical, the umbilical shoulder narrowly rounded. The whorl section is slightly compressed, the whorl breadth to height ratio 0.91. The inner flanks are flattened and subparallel, the outer flanks convergent, the ventrolateral shoulders

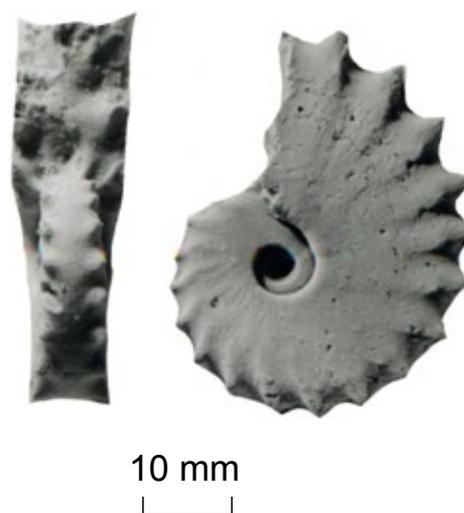


Fig. 15: The lectotype of *Acanthoceras suzannae* Pervinquier, 1907 (p. 298, pl. 16, figs 12-13), an unregistered specimen in the Sorbonne Collections, from Guern er Rhezal, Tunisia.

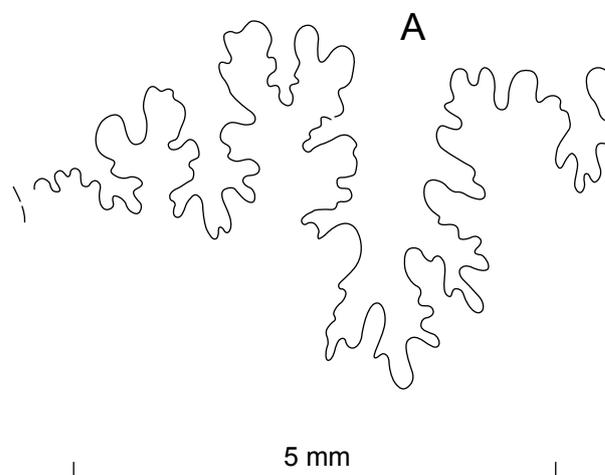


Fig. 16: Partial external suture line of *Graysonites cherbensis* (Thomas & Peron, 1889), OUM KX4055.

rounded, the venter flattened. Eighteen small, sharp bullae perch on the umbilical shoulder. At the smallest diameter visible, they give rise to narrow, distant, straight, prorsiradiate ribs that bear small bullate inner ventrolateral tubercles and sharp, high outer ventrolateral clavi. There may also be intercalated ribs. As size increases, preservation deteriorates, but the presence of over 30 ribs at the ventrolateral shoulder of the outer whorl indicates the regular insertion of intercalated ribs. The ribs are straight and prorsiradiate on the inner flank, flex forwards and are feebly concave on the outer flank, linking to small inner ventrolateral bullae and outer ventrolateral clavi. The venter is well-preserved for a short section only, and bears a feeble siphonal ridge.

MNHP R52350a (Pl. IX, figs 2, 10), an internal mould of a phragmocone, and although badly corroded, is clearly conspecific. The nucleus, preserved to a diameter of 25.5 mm has involute coiling, the umbilicus comprising 20% of the diameter, shallow, with a low, flattened wall and very narrowly rounded umbilical shoulder. The whorl section is very compressed, with flat, subparallel flanks, narrowly rounded ventrolateral shoulders, and a flat to very feebly convex venter in intercostal section. There are six delicate umbilical bullae per half whorl. These give rise to one or two very delicate prorsiradiate ribs, whilst occasional additional ribs intercalate. All ribs strengthen across the flanks, and link to small, sharp ventral clavi, of which there are 15 per half whorl. There are faint swellings at the inner ventrolateral position on some ribs, but no clearly differentiate inner ventrolateral tubercles. At this growth stage the specimen corresponds to the holotype of *Acanthoceras suzannae* Pervinquier, 1907 (pl. p. 298, pl. 16, figs 12-13; Fig. 15 herein), as described below. The outer whorl of this specimen has the following approximate dimensions:

	D	Wb	Wh	Wb:Wh	U
MNHP R52350a	104.6 (100)	32.0 (30.6)	47.0 (44.9)	0.68	28.6 (27.3)

Coiling is fairly involute, the umbilicus comprising 27.3% of the diameter, shallow, with a low, flattened wall and narrowly rounded umbilical shoulder, the whorl section compressed, with a whorl breadth to height ratio of 0.68. The inner flanks are flattened and subparallel, the outer flanks convergent, the ventrolateral shoulders broadly rounded, the venter very feebly convex. Ten ribs per half whorl arise at the umbilical seam and are weak and concave across the umbilical wall, strengthening into narrow bullae, perched on the umbilical shoulder. These give rise to pairs of weak, feebly flexuous, prorsiradiate crowded ribs that strengthen and coarsen on the outer flanks and ventrolateral shoulders. All bear a delicate mid-lateral bulla where the surface of the mould is well-preserved. The ribs weaken markedly between umbilical and lateral tubercles, producing the impression of a broad, very shallow concave circumbilical inner flank zone. The

ribs strengthen and broaden on the outer flank, and link to stronger inner and outer ventrolateral tubercles. The venter is poorly preserved, but appears to have been smooth, apart from a low siphonal ridge.

The lectotype, here designated, of *Acanthoceras suzannae* Pervinquier, 1907 (p. 298, pl. 16, figs 12-13; Fig. 15) is a limonitic nucleus 10.3 mm in diameter, from Guern er Rhezal in Central Tunisia (Pervinquier 1903, p. 71). Coiling is very involute, the tiny umbilicus comprising 20% of the diameter, shallow, with a vertical wall and very narrowly rounded umbilical shoulder. The whorl section is very compressed, rectangular, with flat, subparallel flanks, broadly rounded ventrolateral shoulders and a narrow, flat venter in intercostal section. The inner to mid-flank region is near-smooth, but for traces of low, broad, prorsiradiate ribs. These arise singly or in pairs, and become conspicuous only on the outer flank, where they link to an elongated inner ventrolateral tubercle, barely differentiated at the adapical end of the outer whorl, but well-differentiated on the adapertural half whorl. A broad rib connects to a sharp outer ventrolateral clavus—or laterally compressed spine—of which there are 22 per whorl, the venter concave between, with a feeble siphonal ridge. The transition from this nucleus to larger specimens is well-shown by individuals such as OUM KX 4094 (Pl. IX, fig. 4), KX4108 (Pl. IX, fig. 8), and KX4055 (Pl. IX, fig. 9). The last of these specimens, although crushed, extends to a whorl height of 16.9 mm. Primary ribs with umbilical bullae alternate with single intercalated ribs, all ribs bear well-developed inner ventrolateral bullae and outer ventrolateral clavi. The ontogeny of well-preserved individuals is continued by two limonitised phragmocone fragments from Djebel Cheniour in Constantine Province, Algeria, in the Sorbonne Collection (Pl. IX, figs 11, 12). These were listed as *Acanthoceras laticlavium* Sharpe sp. by Blayac (1912, p. 305), and may be the specimens mentioned by Pervinquier (1907, p. 300). The smaller (Pl. IX, fig. 12) has a maximum preserved whorl height of 28 mm, and a whorl breadth to height ratio of 0.68. Coiling is moderately involute, the umbilicus shallow, with a feebly convex wall and narrowly rounded umbilical shoulder. The flanks are flattened and subparallel, converging to broadly rounded ventrolateral shoulders and a flattened venter in intercostal section. The costal section is compressed polygonal, with faceted ventrolateral shoulders. There is a low siphonal ridge to accommodate the siphuncle, which is close to the surface. The inner whorls, to a diameter of 32 mm approximately, are partly visible. Delicate umbilical bullae give rise to straight prorsiradiate primary ribs, either singly or in pairs. Initially delicate, they strengthen on the outer flank and are joined by intercalated ribs, all ribs strengthening and feebly concave. On the outer, 120° whorl sector, seven ribs arise on the umbilical wall and strengthen into small prorsiradiate bullae, perched on the umbilical shoulder. These give rise to one or two delicate prorsiradiate ribs that are straight on the inner flank; there

are a few additional intercalated ribs. The ribs are feebly convex across the mid-flank, where they develop a feeble mid-lateral bulla, and feebly concave on the outer flank. All develop a small, feebly bullate inner ventrolateral tubercle that is stronger than the lateral one. A strong, straight prorsiradiate rib sweeps forwards to a stronger, oblique outer ventrolateral clavus. These in turn give rise to weak prorsiradiate ventral ribs that efface before reaching the mid-ventral ridge. The second specimen (Pl. IX, fig. 11), is similar, with a maximum preserved whorl height of 30.8 mm and a whorl breadth to height ratio of 0.68.

The lectotype (by the subsequent designation of Wright & Kennedy, 1984, p. 128) of *Sharpeiceras latyclavium* var. *byzacenica* Pervinquier, 1907 (p. 301, pl. 14, fig. 4: Pl. IX, fig. 1 herein), from Djebel er Rebeiba in Central Tunisia, is the largest well-preserved fragment referred to the species. It is an incomplete 120° whorl sector of phragmocone with a maximum preserved whorl height of 42 mm. Coiling appears to have been fairly involute. The umbilical wall is flattened, the umbilical shoulder rounded. The whorl breadth to height ratio is 0.66, the greatest breadth a little below mid-flank. The inner flanks are flattened and subparallel, the outer flanks slightly convergent. The ventrolateral shoulders are broadly rounded, the venter feebly convex, and raised over the mid-venter. Seven primary ribs arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into small umbilical bullae. These give rise to a single rib or a pair of weak, feebly flexed, prorsiradiate ribs, while additional ribs intercalate. The ribs weaken on the inner flank, producing the impression of a very shallow, concave circumbilical zone, the outer limit of which is marked by a strengthening of the ribs into a feeble mid-lateral bulla. There are 14 ribs at the ventrolateral shoulder, all of which strengthen into small clavi; there is no clearly differentiated inner ventrolateral tubercle, only an angulation in the whorl profile. The venter is smooth between the clavi. The external suture is deeply and intricately incised, with a deep E, narrow A, broad, asymmetrically bifid E/A and A/U2.

Discussion: *Graysonites cherbensis* differs from *Graysonites azregensis* (Amédro, 1994) (*in* Robaszynski *et al.*, pp. 407, 422, pl. 10, figs 3-7, 9), described below, in having a lateral tubercle. That this is not detectable in the holotype, which agrees in all other respects with individuals that do, is a reflection of the very poor preservation of the mid-flank regions of the holotype (Pl. IX, fig. 7b).

Occurrence: Lower Cenomanian of Central Tunisia.

Graysonites azregensis (Amédro, 1994)

Pl. I, figs 3, 4, 6

1994. *Mantelliceras azregensis* Amédro, *in* Robaszynski *et al.*, pp. 407, 422, pl. 10, figs 3-7, 9.
2008. *Graysonites azregensis* (Amédro, 1994).— Amédro *in* Robaszynski *et al.*, p. 263, pl. 5, figs a-d.

Types: The holotype is the original of Amédro *in* Robaszynski *et al.*, 1994, p. 422, pl. 10, fig. 4, MNHP-F-R6269; paratypes are MNHP-F-R630-32, the originals of pl. 10, figs 5, 7, 9 therein, all from the Lower Cenomanian Fahdene Formation of Kef el Azreg, Central Tunisia.

Material: OUM KX1959, from bed 3, and OUM KX1971, from bed 5, Foum el Guelta. OUM KX2414-16, from the base of bed 7 south of Sif et Tella. MNHP R52350b, from Djebel Mrhila, without more precise locality data.

Description: OUM KX1959 (Pl. I, fig. 4) is a part-septate juvenile with a maximum preserved diameter of 47 mm. Coiling is very involute, the umbilicus small and shallow, although damage precludes accurate measurement. The whorl section is compressed trapezoidal, the whorl breadth to height ratio 0.65 approximately, the flanks flattened and convergent, the ventrolateral shoulders rounded, the venter flattened, with a low, blunt median ridge. There are an estimated 20 ribs per half whorl. Primary ribs arise singly or, predominantly, in pairs from tiny umbilical bullae. They are weak, narrow, crowded, and strengthen across the flanks, straight and prorsiradiate on the inner flank, flexing back and very feebly concave on the outer flank. They link to very feeble inner ventrolateral bullae, linked by a low rib to small outer ventrolateral clavi. OUM KX2414 (Pl. I, fig. 3) is a larger phragmocone fragment, with a maximum preserved whorl height of 32 mm approximately. Ribbing is as in the previous specimen, but the inner ventrolateral bullae have effaced, the outer ventrolateral clavi persisting, and separated from the siphonal ridge by a shallow depression. OUM KX2416 (Pl. I, fig. 6) is a 120° sector of phragmocone with a maximum preserved whorl height of 43 mm, and a whorl breadth to height ratio of 0.6 approximately, the ornament as in the previous specimens. The suture is very deeply incised, with a large, bifid E/A, narrow, deep, bifid A, and large, bifid A/U2, with a very narrow stem.

Discussion: *Graysonites azregensis* differs from *G. cherbensis*, discussed above, in lacking a lateral tubercle.

Occurrence: Lower Cenomanian of central Tunisia.

Genus *Utaturiceras* Wright, 1956

Type species: *Ammonites vicinalis* Stoliczka, 1864, p. 84, pl. 44, figs 1, 4, 5, 7, 8, *non* 2, 3, 6, by the original designation of Wright, 1956, p. 392.

Utaturiceras cf. *discoideale* (Kossmat, 1895)

Fig. 17

1895. *Acanthoceras discoideale* Kossmat, p. 201 (105), pl. 25 (11), fig. 1.
2003. *Utaturiceras* cf. *discoideale* (Kossmat, 1895).— Matsu-moto *et al.*, p. 138, text-figs 9, 10.

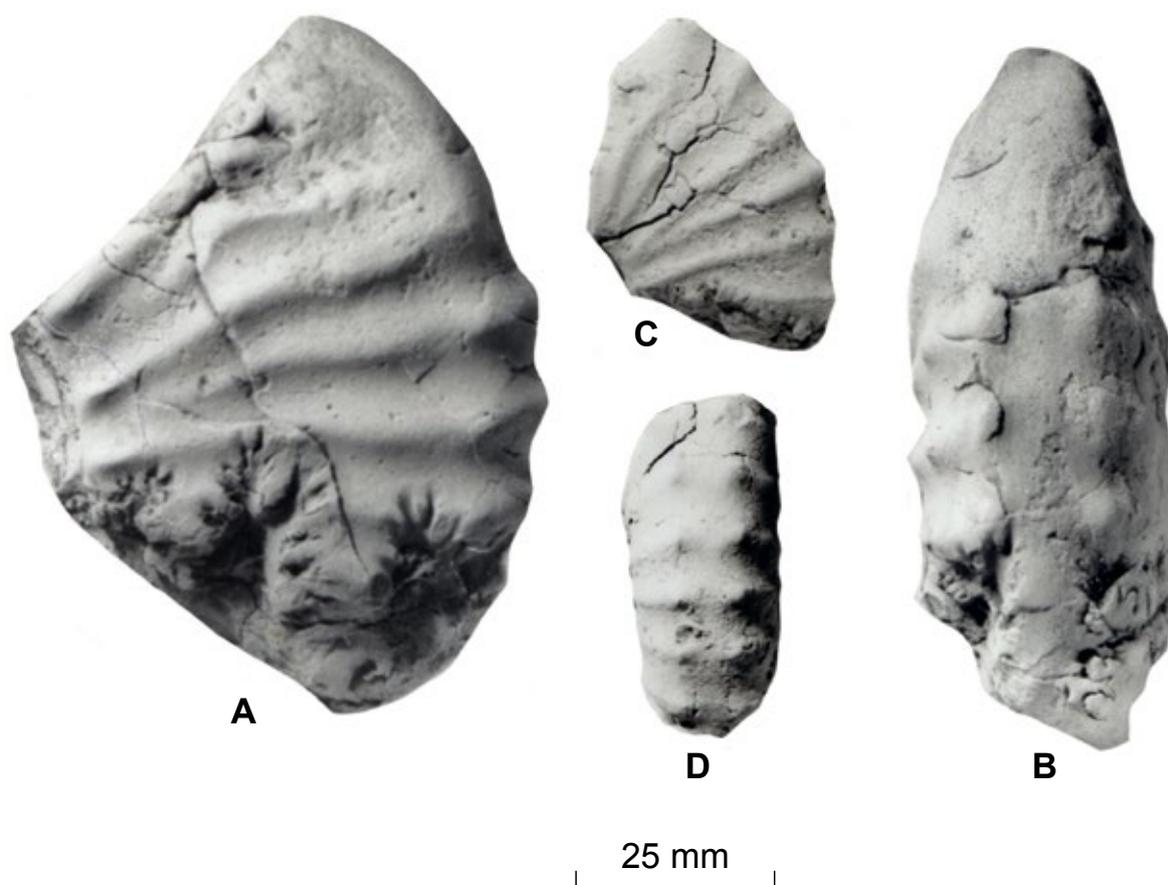


Fig. 17: *Utaturiceras* cf. *discoidale* (Kossmat, 1895). A, B: OUM KX1972 from bed 5; C, D: OUM KX1960, from bed 3 of the Foum el Guelta section.

Type: The holotype, by monotypy, is the original of Kossmat, 1895, p. 201 (105), pl. 25 (11), fig. 1, from the Utatur Group of Odium, Tamil Nadu, South India, in the collections of the Geological Survey of India, Kolkatta. A cast is housed in the collections of the Oxford Museum of Natural History, no. KY961.

Material: OUM KX1960, from bed 3, and OUM KX1972, from bed 5, Foug el Guelta.

Description: OUM KX1960 (Fig. 17C, D) is a partly septate 120° whorl sector with a maximum preserved whorl height of 29 mm. The umbilicus is shallow, with a low, convex, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is compressed ovoid in intercostal section with feebly convex, converging flanks, broadly rounded ventrolateral shoulders, and a very feebly convex, flattened venter. The costal whorl breadth to height ratio is 0.7. There are six low, broad primary ribs on the fragment, arising in pairs from very feeble umbilical bullae, and strengthening across the flanks. The ribs are straight and prorsiradiate on the inner flank, and very slightly concave on the outer. The ribs bear very feeble inner ventrolateral bullae, and very strong rounded outer ventrolateral tubercles, linked

across the venter by a low, broad rib. OUM KX1972 (Fig. 17A, B) is a 90° whorl sector from the adapical end of the body chamber, with a maximum preserved whorl height of 53.5 mm and a whorl breadth to height ratio of 0.5 approximately (the specimen has been deformed by *post-mortem* crushing). The umbilicus is shallow, with a low, very feebly convex wall and broadly rounded umbilical shoulder. There are three widely separated, narrow bullae on the ventrolateral shoulder. They give rise to single ribs, with single long intercalated ribs, some almost linked to a bulla. The ribs broaden across the flanks, and are narrow and prorsiradiate on the inner flank, broadening at mid-flank, and very feebly concave on the outer flank, linking to blunt rounded-bullate inner ventrolateral tubercles, from which a broad rib links to a rounded-very feebly clavate outer ventrolateral tubercle. The venter between is smooth, but for a feeble siphonal ridge. The suture is moderately incised, with a broad bifid E/A and narrower A.

Discussion: *Utaturiceras vicinale* (see revision in Matsumoto & Sarkar, 1966, p. 297, pl. 32, fig. 1, pl. 33, figs 1-3, text-figs 1-4; Wright & Kennedy, 1996, p. 399, pl. 122, fig. 1, text-fig. 156) is more densely and

finely ribbed, the inner ventrolateral tubercles effacing, whereas they persist in *discoïdale* and are linked across the venter by a strong, transverse rib. *Utaturiceras chrysanthemum* Matsumoto *et al.*, 2003 (p. 138, figs 6-8) was differentiated on the basis of its suboval rather than subtrapezoidal whorl section, and more distant and broader ribs on the body chamber, where the tubercles are lost, rather than persisting, as they do in *discoïdale*.

Occurrence: Lower Cenomanian of South India, and, possibly, Hokkaido, Japan, and central Tunisia.

Genus *Mrhiliceras* Kennedy & Wright, 1985

Type species: *Mammites lapparenti* Pervinquière, 1907, p. 312, pl. 14, figs 5, 6; by the original designation of Kennedy & Wright, 1985, p. 514.

***Mrhiliceras lapparenti* (Pervinquière, 1907)**

Pl. VI, figs 1-7

1903. *Mammites cf. conciliatus* Stoliczka.– Pervinquière, pp. 66, 78.
 1907. *Mammites lapparenti* Pervinquière, p. 312, pl. 14, figs 5, 6.
 1964. *Metoicoceras swallowiforme* Collignon, p. 149, pl. 375, fig. 1627.
 1964. *Metoicoceras besairiei* Collignon, p. 149, pl. 375, figs 1628, 1629.
 1978. *Metoicoceras besairiei* Collignon.– Lewy & Raab, p. 112, pl. 1, fig. 10.
 ?1979. *Utaturiceras vicinale* (Stoliczka).– Wiedmann & Schneider, p. 671, pl. 10, figs 2, 5, text-fig. 10.
 ?1984. *Utaturiceras vicinale* (Stoliczka).– Kaplan, Keller & Wiedmann, pl. 1, fig. 2.
 1985. *Mrhiliceras lapparenti* (Pervinquière, 1907).– Kennedy & Wright, p. 516 (*pars*), figs 1a-c; 2, 3, 4d, h only.
 1987. *Mrhiliceras lapparenti* (Pervinquière, 1907).– Wright & Kennedy, p. 137 (*pars*), pl. 42, figs 3, non 5, text-figs 33f, g only, 34f, non 35a.
 2002. *Mrhiliceras lapparenti* (Pervinquière, 1907).– Matsumoto & Nishida, p. 187, text-figs 2, 3.
 2013. *Mrhiliceras lapparenti* (Pervinquière, 1907).– Kennedy *et al.*, p. 643, pl. 5, figs 4, 5.
 2014. *Mrhiliceras lapparenti* (Pervinquière, 1907).– Walaszczyk *et al.*, p. 110, fig. 24f.

Types: The holotype, by original designation, is an unregistered specimen in the Sorbonne Collections from Ain el Glaa, Djebel Bireno, Tunisia, the original of Pervinquière 1907, pl. 14, fig. 5 (Pl. VI, fig. 1). There are three paratypes in the same collection, the original of Pervinquière 1907, pl. 14, fig. 6 (Pl. VI, fig. 2) is also from Ain el Glaa; a specimen from Kef Si Abd El Kader in Djebel Mrhila (Pl. VI, fig. 6), and one from Fom el Guelta in Djebel Mrhila (Pl. VI, fig. 4).

Material: OUM KX1900, from the lower part of bed 13; OUM KX1999-2000, from the base of bed 14, and OUM KX1993, collected loose, but derived from beds 14-17, Fom el Guelta.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
Holotype c	47.5 (100)	23.9 (50.3)	21.7 (45.7)	1.1	10.8 (22.7)
Pl. VI, fig. 2c	- (-)	29.0 (-)	23.2 (-)	1.25	- (-)
Pl. VI, fig. 6c	- (-)	22.2 (-)	22.2 (-)	1.0	- (-)

Description: Coiling is involute, the relatively deep umbilicus comprising 22.7% of the diameter in the holotype, the umbilical wall flattened to very feebly convex, the ventrolateral shoulder broadly rounded. The whorl section is depressed, feebly trapezoidal in intercostal section, with flattened feebly convergent flanks, broadly rounded ventrolateral shoulders, and a broad, flattened venter. The costal whorl section is polygonal, with the greatest breadth at the umbilical bullae; the whorl breadth to height ratio is 1.1. Primary ribs, five per half whorl, arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into strong conical, subspinose tubercles. These give rise to a single rib or a pair of ribs, with additional ribs intercalating around mid-flank to give a total of ten ribs per half whorl at the ventrolateral shoulder. The ribs are very coarse, straight and prorsiradiate, strengthening across the flanks, and linking to strong conical inner ventrolateral tubercles. A broad, feebly prorsiradiate rib links to strong outer ventrolateral clavi, linked across the venter by a broad, transverse rib. The paratype figured by Pervinquière (Pl. VI, fig. 2) is more depressed, with a costal whorl breadth to height ratio of 1.25, all of the flank ribs arising in pairs from the umbilical bullae. OUM KX1999 (Pl. VI, fig. 3), deformed into an ellipse with a maximum diameter of 50 mm, is, in contrast, a relatively slender variant, with a costal whorl breadth to height ratio of 0.9. It retains half a whorl of body chamber, on which bullate primary ribs and single intercalated ribs alternate. It may be a microconch. OUM KX2000 (Pl. VI, fig. 7) is a 120° whorl sector, most of which is body chamber; it may be an incomplete macroconch. The maximum preserved whorl height is 33 mm. Although worn, the umbilical bullae are weakening, and give rise to single ribs, with single intercalatories between. OUM KX1999, although crushed, is a comparable body chamber fragment, showing weakening flank ribs, the venter, in contrast, crossed by strong transverse ribs, the ventrolateral tubercles weakening.

The suture (Wright & Kennedy, 1985, text-fig. 1a) is moderately incised, with a broad, asymmetrically bifid E/A, very narrow A, and broader A/U2.

Discussion: As noted elsewhere (Kennedy *et al.*, 2013, p. 643) Matsumoto (2002) questioned the proposal of Kennedy & Wright (1985, p. 520) that the compressed species *Metoicoceras sakarahense* Collignon, 1964 (p. 150, pl. 375, figs 1630-1632) and *M. fasciculatum*

Collignon, 1964 (p. 151, pl. 375, fig. 1633) were intraspecific variants of *lapparenti*, and his view is followed here. I also now doubt the reference of some German and English material to the species, and this is reflected in the revised synonymy and occurrence data.

Occurrence: Lower Cenomanian of southern England, Central Tunisia, Israel, Japan and Madagascar.

Genus *Sharpeiceras* Hyatt, 1903

Type species: *Ammonites laticlavium* Sharpe, 1855, p. 31, pl. 14, fig. 1, by the original designation of Hyatt, 1903, p. 111.

Sharpeiceras laticlavium (Sharpe, 1855)

Pl. X, fig. 3

1855. *Ammonites laticlavium* Sharpe, p. 31, pl. 14, fig. 1.
 1984. *Sharpeiceras laticlavium* (Sharpe, 1855).— Wright & Kennedy, p. 127, pl. 41, fig. 4; text-figs 29, 30, 34a (with full synonymy).
 1991. *Sharpeiceras laticlavium* (Sharpe, 1855).— Delamette & Kennedy, p. 454, figs 9.9, 9.10.
 1994. *Sharpeiceras laticlavium* (Sharpe, 1855).— Kennedy, p. 225.
 1994. *Sharpeiceras laticlavium* (Sharpe, 1855).— Amédro in Robaszynski *et al.*, p. 412, pl. 11, fig. 3.
 1996. *Sharpeiceras laticlavium* (Sharpe).— Marcinowski *et al.*, pl. 13.
 1998. *Sharpeiceras laticlavium* (Sharpe, 1855).— Kaplan *et al.*, p. 126, pls 27-30.
 2010. *Sharpeiceras laticlavium* (Sharpe, 1855).— Amédro & Robaszynski, p. 13, pl. 1, fig. 1.
 2012. *Sharpeiceras laticlavium* (Sharpe, 1855).— Amédro *et al.*, p. 11, pl. 3, fig. 2, pl. 4, figs 12, 2.

Type: The holotype, by monotypy, is no. 7755 in the collections of the British Geological Survey, from the Lower Chalk of Bonchurch, Isle of Wight, the original of Sharpe, 1855, pl. 14, fig. 1. It was refigured by Wright & Kennedy, 1987, pl. 41, fig. 4.

Material: OUM KX2393, from the base of bed 7, south of Sif et Tella.

Description: The specimen is a 120° whorl sector with a maximum preserved whorl height of 25 mm. Coiling is evolute, the umbilicus shallow, with a low subvertical feebly convex wall and quite narrowly rounded umbilical shoulder. The whorl section is compressed, with flattened, parallel flanks, broadly rounded ventrolateral shoulders and a flattened venter in intercostal section. The costal whorl section is compressed polygonal, with a whorl breadth to height ratio of 0.74. Primary ribs arise at the umbilical seam, strengthen, sweep back across the umbilical wall and develop into small bullae perched on the umbilical shoulder. The bullae give rise to straight prorsiradiate ribs, while additional ribs intercalate low on the flank to give a total of 12 ribs at mid-flank. The ribs are crowded, and bear small mid-lateral bullae, stronger conical inner and feebly clavate outer ventrolateral tubercles, the venter smooth between.

Discussion: Although only a fragment, the style of the crowded ribbing and the tuberculation correspond to that of the adapical part of the outer whorl of the holotype. It is easily distinguished from co-occurring fragments of *Sharpeiceras florencae* of the same size by the sparser ribbing and coarser tuberculation of the latter (compare Pl. X, figs 3 and 5).

Occurrence: Lower Cenomanian of southern England, northern, western and southeastern France, Switzerland, Romania, Central Tunisia, Israel, Lebanon, Iran, Madagascar, and northern KwaZulu-Natal in South Africa.

Sharpeiceras schlueteri Hyatt, 1903

Pl. X, figs 2, 5, 10; Pl. XI, figs 1, 2; Text-fig. 18

1871. *Ammonites laticlavium* Sharpe.— Schlüter, p. 18 (*pars*), pl. 7, figs 4-8.
 1903. *Sharpeiceras schlueteri* Hyatt, p. 111.
 1987. *Sharpeiceras schlueteri* Hyatt.— Wright & Kennedy, p. 129, pl. 41, figs 1, 3, text-figs 32, 33j, 34d, e.
 1991. *Sharpeiceras schlueteri* Hyatt, 1903.— Delamette & Kennedy, p. 454.
 1994. *Sharpeiceras schlueteri* Hyatt, 1903.— Amédro in Robaszynski *et al.*, p. 412, pl. 11, figs 1, 2.
 1998. *Sharpeiceras schlueteri* Hyatt, 1903.— Kaplan *et al.*, p. 128, pl. 31, pl. 32, pl. 33, figs 3, 4.
 2002. *Sharpeiceras schlueteri* Hyatt, 1903.— Amédro, Cobban, Bréton & Rogron, pl. 11, fig. 5.

Types: The lectotype, by the subsequent designation of Wright & Kennedy (1987, p. 130) is the original of Schlüter 1871, pl. 7, figs 4, 5, from a mine shaft near Altessen, Germany. It has not been traced. The surviving paralectotype is a *Sharpeiceras laticlavium*, and was refigured by Wright & Kennedy (1987, text-fig. 30) and Kaplan *et al.* (1998, pl. 28).

Material: OUM KX 1963-69, from bed 3; OUM KX1980-81, from bed 5; OUM KX1931, 1933, 1963-1969, 2391-2, 2394, from the base of bed 7, Fom el Guelta. OUM KX1196-7, from the base of bed 5 south of Sif et Tella. OUM KX823 from central Djebel Mrhila. MNHP R52356, from Djebel Mrhila, without more precise locality data.

Description: Phragmocone fragments range from whorl heights of 20-70 mm. The best-preserved small fragment is MNHP R52356 (Pl. X, fig. 5), a 60° whorl sector with a maximum preserved whorl height of 29.5 mm, the whorl section rectangular, with a whorl breadth to height ratio of 0.8. There are six ribs on the fragment. They arise at the umbilical seam and are strong and coarse on the umbilical wall and shoulder, where they strengthen into strong, sharp bullae. The ribs are straight and prorsiradiate on the flanks, weakest on the inner flank, before strengthening into a coarse mid-lateral bulla linked by a stronger, coarser rib to coarse inner ventrolateral bullae and outer ventrolateral clavi. The venter is narrow, and smooth between the clavi. OUM KX1969 (Pl. X, fig. 1) has a

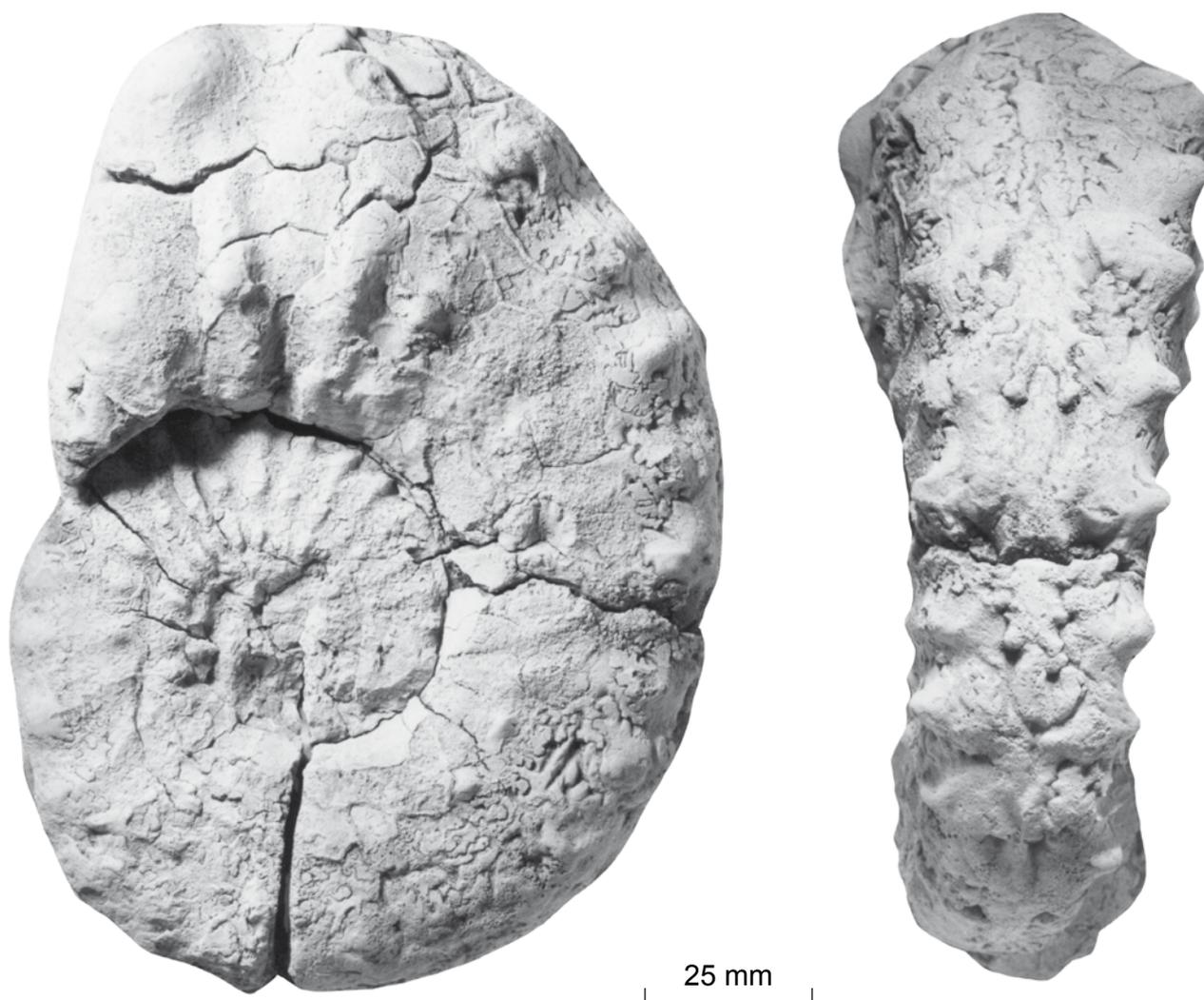


Fig. 18: *Sharpeiceras schlueteri* (Hyatt, 193), OUM KX823, from the correlative of bed 5 of the section south of Sif et Tella, central Djebel Mrhila.

maximum preserved whorl height of 48 mm. One flank is badly worn, and the original whorl proportions cannot be established accurately, although clearly compressed, with flat subparallel flanks, broadly rounded ventrolateral shoulders and a very feebly convex venter in intercostal section. There are seven ribs on the fragment. All are primaries that arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into small bullae. The ribs are straight and prorsiradiate on the flanks, across which they broaden and coarsen, with larger mid-lateral bullae, strong conical inner ventrolateral tubercles and weaker outer ventrolateral clavi, the venter smooth between. OUM KX823 (Fig. 18) is a complete but distorted individual that retains a short sector of body chamber. The maximum preserved diameter is 155 mm. Coiling is very evolute, the umbilicus comprising 35% approximately of the diameter, shallow, with a feebly convex wall and broadly rounded umbilical shoulder. The intercostal whorl

breadth to height ratio is 0.77 approximately. The flanks are flattened and subparallel, the ventrolateral shoulders broadly rounded. The venter is feebly convex. There are approximately 24 ribs on the outer whorl, becoming coarser and more widely separated as size increases. They arise at the umbilical seam, strengthen across the wall and shoulder and are straight and prorsiradiate on the flanks, with small umbilical bullae, larger mid-lateral bullae, larger conical inner ventrolateral tubercles and smaller outer ventrolateral clavi. The venter is smooth between. OUM KX1980 (Pl. XI, fig. 1) is a particularly well-preserved fragment, part phragmocone, part body chamber, with a maximum preserved whorl height of 48 mm. There are parts of seven strong, narrow, widely separated prorsiradiate ribs on the fragment, with weak umbilical and lateral bullae. Stronger inner ventrolateral bullae are linked by a strong rib to smaller outer ventrolateral clavi, the venter smooth between. The weak lateral and ventrolateral tuberculation suggest the

specimen may be part of a small adult. A fragment from Djebel Rebeiba mentioned by Pervinquière (1907, p. 302; Pl. X, fig. 2 herein) under *Acanthoceras laticlavium*, is particularly well-preserved. It is wholly septate, with one flank crushed. The maximum preserved whorl height is 44.2 mm. Parts of nine ribs are preserved. They are strong and narrow on the flanks, and separated by broader interspaces, straight and prorsiradiate, with small sharp umbilical bullae, larger sharp mid-lateral bullae, and strong subspinose inner ventrolateral tubercles, linked by a strong transverse rib to strong outer ventrolateral clavi. Many of the specimens show the sutures, which are deeply incised; E/A is large, with a deep median element, A large, deep and relatively narrow, A/U2 large and bifid, with a narrow stem.

Occurrence: Lower Cenomanian, index of the middle

subzone of the *mantelli* Zone of the Northwest European standard zonation with records from southern and eastern England, the Boulonnais, Haute-Normandie, Sarthe and Provence in France, Switzerland, Central Tunisia, Peru, Venezuela, Angola, Mozambique, and Madagascar.

***Sharpeiceras florencae* Spath, 1925**

Pl. XI, fig. 3; Text-fig. 19

1925. *Sharpeiceras florencae* Spath, p. 198, pl. 37.
 1933. *Sharpeiceras florencae* Spath.— Collignon, p. 67, pl. 6, fig. 5.
 1956. *Sharpeiceras occidentale* Benavides-Cáceres, p. 465, pl. 54, figs 5, 6.
 1959. *Sharpeiceras cf. florencae* Spath.— Matsumoto, pp. 69, 70; text-fig. 28.

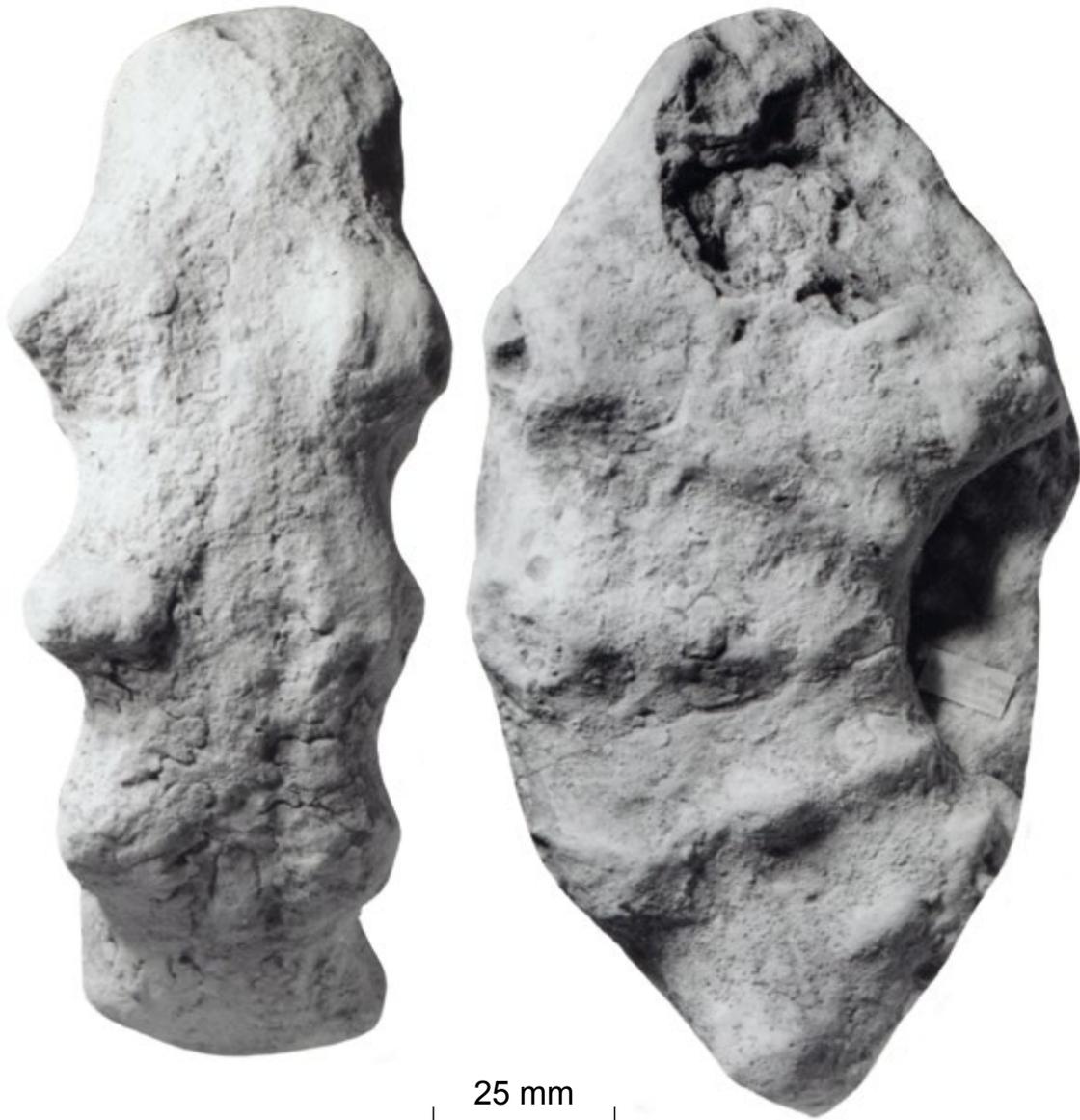


Fig. 19: *Sharpeiceras florencae* Spath, 1925, OUM KX1198, from bed 5 of the section south of Sif et Tella.

1962. *Tlahualiloceras tlahualiloense* Kellum & Mintz, p. 276, pl. 6, fig. 1, pl. 7, figs 1, 2, pl. 8, fig. 1.
1964. *Sharpeiceras schlueteri* Hyatt.– Collignon, p. 102, pl. 353, fig. 1564.
1964. *Sharpeiceras vohipalense* Collignon, p. 104, pl. 354, fig. 1565.
- non 1971. *Sharpeiceras florencae* Spath.– Kennedy, p. 67, pl. 25, fig. 2.
1985. *Sharpeiceras florencae* Spath.– Howarth, p. 86, text-figs 15-19.
1998. *Sharpeiceras florencae* Spath, 1925.– Matsumoto & Toshimitsu, p. 622, pl. 1 (with additional synonymy).
2011. *Sharpeiceras florencae* Spath, 1925.– Meister *et al.*, p. 695, pl. 25, fig. 1, pl. 26, figs 1, 2, pl. 27, fig. 1, pl. 28, fig. 1, pl. 29, fig. 1, pl. 30, fig. 1, pl. 31, fig. 1, pl. 32, figs 1, 2, pl. 33, figs 1, 2, pl. 34, figs 1, 2, pl. 35, figs 1, 2, pl. 36, fig. 2, pl. 37, fig. 1.
- ?2011. *Sharpeiceras florencae crassum* Meister *et al.*, p. 697, pl. 22, fig. 1; pl. 23, figs 1, 2; pl. 24, fig. 1.
- ?2013. *Sharpeiceras cf. florencae* Spath, 1925.– Kennedy *et al.*, p. 641, pl. 6, fig. 1.

Type: The holotype, by monotypy, is the original of Spath, 1925, p. 19, pl. 37, in the collections of the Ditsong Museum of Natural History (formerly the Transvaal Museum), Pretoria, from northeastern KwaZulu-Natal, South Africa ('Pondoland').

Material: OUM KX1070 and 1198, from bed 5, Foum el Guelta.

Description: OUM KX1070 (Pl. XI, fig. 3) is a 120° sector of phragmocone with a maximum preserved whorl height of 72 mm. Coiling is evolute, the umbilicus of moderate depth, the umbilical wall feebly convex, the umbilical shoulder broadly rounded. The intercostal whorl section is compressed, with a whorl breadth to height ratio of 0.82, the flanks moderately convex, the ventrolateral shoulders broadly rounded, the venter relatively broad, and flattened to very feebly convex. The costal whorl breadth to height ratio is 0.93, the greatest breadth at the mid-lateral tubercles. There are six very widely separated primary ribs on the fragment. They arise at the umbilical seam, and are low and broad on the umbilical wall, strengthening into small sharp bullae, perched on the umbilical shoulder. The bullae give rise to a straight recti-to feebly prorsiradiate rib that broadens and strengthens across the flanks, strengthening into a sharp mid-lateral bulla only a little stronger than the umbilical. A broadening rib links to a stronger conical inner ventrolateral tubercle, and thence to a weaker outer ventrolateral clavus, the venter smooth between the clavi. OUM KX1198 (Text-fig. 19) is a 120° sector of body chamber with a maximum preserved whorl height of 72 mm. Parts of five ribs are preserved on the fragment, with well-developed umbilical and mid-lateral bullae, as in the previous specimen, the inner ventrolateral tubercles much stronger, and developing into a large conical-feebly bullate horn, the outer ventrolateral clavus weak.

Discussion: *Sharpeiceras goliath* Haas, 1942 (p. 7,

text-figs 5-7) was revised by Meister, Buta, David & Tavares (2011, p. 600); it is an Upper Albian species of *Arestoceras* van Hoepen, 1942. *Sharpeiceras occidentale* Benavides-Cáceres, 1956 (p. 465, pl. 54, figs 5, 6), from the Lower Cenomanian of Peru, is interpreted as a relatively weakly tuberculate variant of *S. florencae*. *Tlahualiloceras tlahualiloense* Kellum & Mintz, 1962 (p. 276, pl. 6, fig. 1; pl. 7, figs 1, 2; pl. 8, fig. 1), from the Lower Cenomanian part of the Indidura Formation of the Sierra de Tlahualilo, Coahuila, northern Mexico, differs in no significant respects, and is a clear synonym, as is the original of *Sharpeiceras schlueteri* Collignon 1964 (p. 103, pl. 353, fig. 1564, non Hyatt, 1903), and the holotype of *Sharpeiceras vohipalense* Collignon, 1964 (p. 104, pl. 354, fig. 1565). *Sharpeiceras schlueteri* Hyatt, 1903 [see Kaplan *et al.*, 1998 (p. 128, pl. 31, 32, pl. 33, figs 3, 4)]; it is a very evolute species, the intercostal section compressed oval to trapezoidal in early and middle growth, the whorls expanding slowly, with 23-29 ribs per whorl, the number increasing as diameter increases. The adult body chamber shows coarsening ornament but never reaches the degree of coarseness shown by *florencae*.

Occurrence: Lower Cenomanian of northern KwaZulu-Natal South Africa, Madagascar, Angola, Central Tunisia, Peru, and northern Mexico.

Sharpeiceras mocambiquense (Choffat, 1903)

Pl. XI, fig. 4; Text-fig. 20

1903. *Acanthoceras laticlavium* (Sharpe) var. *moçambiquensis* Choffat, p. 25, pl. 4, fig. 3, pl. 7, fig. 1.
1987. *Acanthoceras laticlavium* var. *moçambiquensis* Choffat.– Wright & Kennedy, p. 127.
1998. *Sharpeiceras mocambiquense* (Choffat).– Matsumoto & Toshimitsu, p. 624, pls 2, 3.
1999. *Sharpeiceras mocambiquense* (Choffat).– Matsumoto *et al.*, p. 19, text-fig. 1.
2013. *Sharpeiceras mocambiquense* (Choffat, 1903).– Kennedy *et al.*, p. 640, pl. 4, figs 8, 9, pl. 6, fig. 2.

Type: The holotype, by monotypy, is the original of Choffat, 1903, p. 25, pl. 4, fig. 3, pl. 7, fig. 1, from the Cenomanian of Conducia, in northeastern Mozambique.

Material: OUM KX1978-9, from bed 5, Foum el Guelta. OUM KX1055, from bed 5, south of Sif et Tella.

Description: OUM KX 1055 is a worn 60° sector of phragmocone with a maximum preserved whorl height of 59 mm, and an approximate whorl breadth to height ratio of 0.6. The umbilicus is shallow, the umbilical wall low and feebly convex, the umbilical shoulder more narrowly rounded. The whorl section is rectangular to feebly trapezoidal in intercostal section, with broadly rounded ventrolateral shoulders and a flattened venter. There are parts of six ribs on the fragment. Three are complete, and are primaries, arising from elongate umbilical bullae of variable strength. They are feebly prorsiradiate, straight,



Fig. 20: *Sharpeiceras mocambiquense* (Choffat, 1903), OUM KX1978, from bed 5 of the Foum el Guelta section.

and strengthen progressively across the flanks. All bear a weak inner lateral bulla, a weak, rounded outer lateral tubercle, a strong inner and weak outer ventrolateral clavus. OUM KX1969 (Pl. XI, fig. 4) is a better-preserved 90° whorl sector with a maximum preserved whorl height of 66 mm, part adult phragmocone, part body chamber of a presumed microconch. The whorl section is compressed, with a costal whorl breadth to height ratio of 0.62. Parts of eight ribs are preserved on the phragmocone fragment. Four bear feeble umbilical bullae, four are either long intercalatories or arise at the umbilical shoulder without developing a bulla. The ribs are straight and prorsiradiate, broadening across

the flanks, and bearing feeble inner lateral bullae, even weaker outer lateral bullae, plus stronger conical inner ventrolateral and conical to feebly clavate outer ventrolateral tubercles. There is a feeble siphonal ridge, the venter otherwise smooth.

OUM KX1978 (Text-fig. 20) is a 90° fragment of macroconch body chamber with a maximum preserved whorl height of 100 mm. The umbilical wall is feebly convex and outward-inclined, the intercostal whorl section compressed, the whorl breadth to height ratio 0.55, the flanks flattened and subparallel, the ventrolateral shoulders broadly rounded, the venter feebly convex. There are eight coarse, distant, prorsiradiate ribs on

the fragment. They are weak on the umbilical wall, strengthening into feeble umbilical bullae, the ribs strengthening on the flanks, and linking to an inner ventrolateral bulla, subspinose at the adapical end of the fragment, but weakening and effacing towards the adapertural end. A strong rib is strengthened further on the outer flank, to produce a long outer lateral bulla, only poorly differentiated from the rib. This also weakens and effaces towards the adapertural end of the fragment. A strong inner ventrolateral bulla is linked by a strong, high rib to a strong outer ventrolateral clavus, the venter deeply sulcate between the clavi in costal section. The ventrolateral tubercles weaken towards the adapertural end of the specimen, the ventrolateral shoulder marked by a strong rib with poorly differentiated tubercles that weaken progressively on the adaperturalmost three ribs. The suture is deeply and intricately subdivided, the saddles with subphylloid folioles, E/A bifid with a deep median incision, A deep, and A/U2 large with a narrow stem.

Discussion: The combination of a compressed whorl section and the presence of an outer lateral tubercle from an early ontogenetic stage separates *S. mocambiquense* from other species in the present faunas. See Kennedy *et al.*, 2013 (p. 641) for further discussion.

Occurrence: Lower Cenomanian of northern Mozambique, KwaZulu-Natal in South Africa, Madagascar, Central Tunisia, and Japan.

Subfamily Acanthoceratinae de Grossouvre, 1894
Genus *Acompsoceras* Hyatt, 1903

Type species: *Ammonites bochumensis* Schlüter, 1871, p. 1, pl. 1, figs 1-4, by original designation by Hyatt, 1903, p. 111 = *Ammonites renevieri* Sharpe, 1857, p. 44, pl. 20, fig. 2.

***Acompsoceras renevieri* (Sharpe, 1857)**

Pl. XII, figs 1-3, 5-7, Pl. XIII, figs 1, 4, 5

1857. *Ammonites Renevieri* Sharpe, p. 44, pl. 20, fig. 2.
1871. *Ammonites Bochumensis* Schlüter, p. 1, pl. 1, figs 1-4; pl. 2, fig. 1.
1903. *Acompsoceras inconstans* Schlüter.– Pervinquierè, p. 83 (*pars*).
1907. *Acompsoceras Sarthense* Guéranger.– Pervinquierè, p. 303 (*pars*), pl. 17, fig. 1 only.
1907. *Acompsoceras essendiense* Schlüter.– Pervinquierè, p. 306, pl. 17, figs 4-7.
1987. *Acompsoceras renevieri* (Sharpe, 1857).– Wright & Kennedy, p. 140, pl. 43, fig. 2, text-figs 34g, 35d-f, 36a-f, 37-40, 43d, e (with full synonymy).
1992. *Acompsoceras renevieri* (Sharpe, 1857).– Thomel, pl. 33, fig. 5.
1993. *Acompsoceras renevieri* (Sharpe, 1857).– Kennedy & Juignet, p. 146, figs 1d, f, 2b, c, e, f, 3a-c, 4a, b, 5a, b, 6c, d, 7c, d, 8d-h.
1994. *Acompsoceras renevieri* (Sharpe, 1857).– Amédro *in* Robaszynski *et al.*, p. 412, pl. 11, fig. 4.

1998. *Acompsoceras renevieri* (Sharpe, 1857).– Kaplan *et al.*, p. 136, pl. 10, figs 6, 7, pl. 34, pl. 35, pl. 36, figs 1-3, pl. 37, figs 4-6, pl. 38, pl. 40, pl. 41, figs 1, 5 (with additional synonymy).
2011. *Acompsoceras renevieri* (Sharpe, 1857).– Kennedy *et al.*, p. 223, text-fig. 12.
2013. *Acompsoceras renevieri* (Sharpe, 1857).– Wilmsen *et al.*, p. 504, text-fig. 9a-e.
2013. *Acompsoceras renevieri* (Sharpe, 1857).– Kennedy *et al.*, p. 644, pl. 8, figs 7, 8.
2014. *Acompsoceras renevieri* (Sharpe, 1857).– Walaszczyk *et al.*, p. 108, text-fig. 24i, j.

Types: The lectotype, designated by Wright & Wright (1951, p. 38), is GSM 7753 (figured by Wright & Kennedy, 1987 pl. 43, fig. 2), from Blackdown, Isle of Wight, the original of Sharpe, 1857, pl. 20, fig. 2. The paralectotypes have not been traced.

Material: Unregistered specimens in the Sorbonne Collections are the originals of Pervinquierè's pl. 17, figs 1, 4, 5, 6, 7, from Kef Si Abd el Kader. OUM KX1951-2, from bed 8, OUM KX2021, 2024-9 from bed 9, and OUM KX1939, collected loose, from Foum el Guelta. OUM KX1397-8, 1399/1401 (parts of one specimen), 1429, 3114, 3154-61, 3280-82, 3284-6 from bed 8, OUM KX1429, from bed 10 south of Sif et Tella.

Description: The material is entirely made up of phragmocone fragments, with whorl heights ranging from 21-122 mm. The species is highly variable, as recognised already by Pervinquierè (1907, p. 303). Feebly ornamented variants correspond to his variety *madjeurensis*. OUM KX2001 (Pl. XII, fig. 3) is a crushed juvenile fragment, with a whorl height of 36 mm. Coiling is involute, the umbilicus shallow, the whorl section compressed, with feebly convex inner flanks, flattened convergent outer flanks, narrowly rounded ventrolateral shoulders, and a feebly convex venter with a blunt siphonal ridge. There are indications of sparse umbilical bullae, and numerous tiny clavi, perched on the ventrolateral shoulder. OUM KX3285 (Pl. XIV, fig. 7) is a 120° whorl segment with a maximum preserved whorl height of 62 mm. The umbilical wall is feebly convex and outward-inclined, the umbilical shoulder broadly rounded. There are five relatively weak umbilical bullae that give rise to feeble, low straight, prorsiradiate primary ribs, while additional intercalated ribs arise at various points on the flanks, becoming distinct only on the outermost flank, where they link to small clavi, perched on the ventrolateral shoulder, of which there are fourteen on the fragment. The venter is smooth, and feebly convex. OUM KX3158 (Pl. XII, fig. 6), is 133.2 mm in diameter, and the most complete specimen, although part-crushed. The shallow umbilicus comprises 12% of the diameter, the umbilical wall low, feebly convex, and outward-inclined, the umbilical shoulder broadly rounded. Where uncrushed, the whorl breadth to height ratio is 0.55, the inner to middle flanks feebly convex, the outer flanks flattened and converging to quite narrowly rounded ventrolateral shoulders, the

venter feebly convex. There are five weak umbilical bullae on the fragment; the flanks are near-smooth, but for feeble radial undulations. Small ventral clavi, well-developed on the adapical half of the fragment, decline on the adapical part. OUM KX2026 (Pl. XII, fig. 2) is a 120° whorl sector with a maximum preserved whorl height of 49.8 mm and a whorl breadth to height ratio of 0.56. There are six well-developed umbilical bullae on the fragment that give rise to low, straight, prorsiradiate ribs either singly, or with a second rib feebly linked to the same bulla. Additional ribs intercalate, and all link to well-developed ventral clavi, of which there are 15 on the fragment. The original of Pervinquierè, 1907, pl. 17, figs 6, 7, is the basis for his variety *madjerensis*, and is illustrated here as Pl. XII, fig. 1. An artificial cast of the dorsum of the specimen was illustrated by Pervinquierè as his pl. 17, fig. 6. This shows, at a whorl height of 18 mm a 42 mm long, 90° whorl sector with 10 feebly flexuous primary and intercalated ribs of varying length, feebly convex on the inner flank, and feebly concave on the outer flank with tiny outer lateral/inner ventrolateral, and outer ventrolateral tubercles. The actual specimen is a 120° sector of phragmocone with a maximum preserved whorl height of 69.9 mm, the whorl breadth to height ratio 0.56. Coiling is very involute, with a tiny, shallow umbilicus. The inner flanks are feebly convex, the outer flanks flattened and convergent, the ventrolateral shoulders broadly rounded, the venter feebly convex. One flank is badly corroded, the other, figured flank lacks the inner third. On the middle to outer flank the ornament consists of delicate narrow prorsiradiate ribs that efface towards the adapertural end of the fragment. At the adapical end, the ribs sweep forwards on the ventrolateral shoulder and terminate in delicate conical to feebly clavate ventral tubercles. These give rise to a low wedge-shaped rib that effaces before reaching the venter. The tubercles decline progressively and are absent from the adapertural half of the fragment. Decline of ventral tubercles but persistence of umbilical bullae is shown by the specimen illustrated by Pervinquierè as his pl. 17, fig. 5 (which we have not traced), and persistence of both tubercles to a large size by the original of his pl. 17, fig. 4 (which we have also not traced), both of which Pervinquierè referred to his variety *mrhilensis*. Other large fragments, such as OUM KX3161 (Text-fig. 21) lack all tuberculation on the phragmocone at a whorl height of 98 mm.

The original of Pervinquierè 1907, pl. 17, fig. 1 (Pl. XIII, fig. 4), is interpreted as juvenile of a strongly ornamented variant of the species. It is a just under 180° sector of phragmocone 67.6 mm long, with a maximum preserved whorl height of 28.7 mm. The umbilicus is of moderate depth, the umbilical wall flattened and outward-inclined, the umbilical shoulder broadly rounded. The costal whorl breadth to height ratio is 0.86, the greatest breadth at the umbilical bullae. Six ribs arise at the umbilical seam, and are low, broad, and feebly prorsiradiate across the umbilical wall, and strengthen into small, sharp umbilical bullae. These give rise to pairs of ribs, the adapical of

the pairs feebly linked to the bulla compared with the adapertural. There are 12 ribs at the ventrolateral shoulder. They are feebly prorsiradiate and feebly flexuous, convex on the inner, and concave on the outer flank, where they link to prominent ventral clavi, linked across the venter by a low transverse rib. There is a suggestion in places of a not entirely convincing inner ventrolateral bulla. Pervinquierè (1907, explanation of plate 17) described this specimen as “montrant que 3 tubercles de chaque côte (le troisième a disparu)”. OUM KX3282 (Pl. XII, fig. 7) is a coarser ribbed individual with a maximum preserved whorl height of 37 mm, and although worn, has a feeble inner ventrolateral tubercle. The largest of the coarsely ribbed individuals is OUM KX1399/1401 (parts of one individual: Pl. XIII, fig. 5), a 180° whorl sector of phragmocone with a maximum preserved whorl height of 71 mm. The costal whorl breadth to height ratio is 0.69, the greatest breadth on the inner flank. Blunt primary ribs, eight per half whorl, arise at the umbilical seam, and pass straight across the umbilical wall, strengthening into strong, sharp bullae, perched on the umbilical shoulder. These give rise to pairs of low, broad primary ribs on the adapical half of the specimen, and single ribs on the adapertural part, where single short ribs intercalate. The ribs broaden across the flanks, and link to strong ventral clavi, the venter concave between.

The suture (Fig. 13A, D) is deeply incised, with distinctive rounded terminations to the folioles, becoming subphylloid. E/A is broad, and symmetrically bifid, A broad and trifid, A/U2 smaller and bifid.

Discussion: None of the specimens in the present collection is adult; all are phragmocone fragments, and differences between individual specimens of the same size may be in part a reflection of them representing different ontogenetic stages of dimorphs. *Acompsoceras renevieri*, as here interpreted, is a variable species in which feebly ornamented individuals have weak umbilical and outer ventrolateral tubercles, on the inner whorls that may be lost in adults, corresponding to *Acompsoceras bochumense* (Schlüter, 1871) (p. 1, pl. 1, figs 1-4; pl. 2, fig. 1; see Wright & Kennedy, 1987, text-figs 35d-f, 37; Kaplan *et al.*, 1998, pls 34, 35, pl. 37, figs 4-6), more robustly ornamented juveniles in which an inner ventrolateral tubercle may develop, and those with very coarse ribs, as with the lectotype of *Acompsoceras sarthense* (Guéranger, 1867, pl. 4, fig. 1; Wright & Kennedy, 1987, text-fig. 36d-f). The range of variation shown by the material from Djebel Mrhila thus matches that shown by juveniles from Western Europe illustrated by Wright & Kennedy (1987) and Kaplan *et al.* (1998). The second species recognised here, *Acompsoceras inconstans* (Schlüter, 1871) (p. 7, pl. 3, figs 1-5) (see Wright & Kennedy, 1987, p. 143, pl. 42, figs 4, 6, 7; pl. 43, fig. 1; text-figs 34c, 41-42, 43a-c, 44; Kaplan *et al.*, 1998, p. 138, pl. 10, figs 8-10; pl. 33, figs 1, 2; pl. 36, figs 4, 5; pl. 37, figs 1-3; pl. 39; pl. 42, figs 3, 4) co-occurs with *A. renevieri*, from which it may be distinguished

by the presence of a lateral tubercle in early and middle growth.

Occurrence: Lower Cenomanian, *M. dixonii* Zone, and lower Middle Cenomanian *C. inerme* Zone. The geographic distribution extends from southern England to Haute Normandie, Sarthe, and Provence in France, Germany, Poland, Iran, Algeria, Central Tunisia, Nigeria (?), and Madagascar.

***Acompsoceras inconstans* (Schlüter, 1871)**

Pl. XII, fig. 5, Pl. XIII, figs 2, 3

1871. *Ammonites inconstans* Schlüter, p. 7, pl. 3, figs 1-5.

1987. *Acompsoceras inconstans* (Schlüter, 1871).— Wright & Kennedy, p. 143, pl. 42, figs 4, 6, 7, pl. 43, fig. 1; text-figs 34c, 41-42, 43a-c, 44 (with full synonymy).

1998. *Acompsoceras inconstans* (Schlüter, 1871).— Kaplan *et al.*, p. 138, pl. 10, figs 8-10; pl. 33, figs 1, 2; pl. 36, figs



Fig. 21: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX3161, from bed 8 of the section south of Sif et Tella.

4, 5; pl. 37, figs 1-3; pl. 39; pl. 42, figs 3, 4 (with additional synonymy).

2010. *Acompsoceras inconstans* (Schlüter, 1871).— Amédéo & Robaszynski, p. 35, pl. 4, fig. 2.

2010. *Acompsoceras inconstans* (Schlüter, 1871).— Kennedy, Amédéo, Robaszynski & Jagt, p. 234, text-figs 13, 19m, n.

Types: The lectotype, by the subsequent designation of Wright & Kennedy, 1987, p. 143, is PIB 30a, the original of Schlüter, 1871, pl. 3, figs 1-3, from the Lower Cenomanian Tourtia near Oberhausen Station, Essen, Germany. It was refigured by Wright & Kennedy (1987, text-fig. 41) and Kaplan *et al.* (1998, pl. 39). Paralectotype PIB 30b is from the Lower Cenomanian Tourtia of Essen. It was refigured by Wright & Kennedy (1987, text-fig. 42) and Kaplan *et al.* (1998, pl. 36, figs 4, 5).

Material: The originals of *Acompsoceras sarthense* Guéranger of Pervinquièrre, 1907, pl. 17, figs 2, 3, unregistered specimens in the Sorbonne Collections. OUM KX1953, from bed 8, Fom el Guelta.

Description: The original of *Acompsoceras sarthense* of Pervinquièrre, 1907, pl. 17, fig. 3 (Pl. XII, fig. 5) is a 60° sector of phragmocone with a maximum preserved whorl height of 24.5 mm and a whorl breadth to height ratio of 0.63. Coiling is evolute, the umbilicus of moderate depth, the umbilical wall convex and outward-inclined, the umbilical shoulder broadly rounded. The greatest breadth is at the umbilical shoulder. The inner flanks are feebly convex, the outer flanks flattened and convergent, the ventrolateral shoulders broadly rounded, and the venter flattened in intercostal section. The costal section is compressed trapezoidal, with the greatest breadth at the umbilical bullae. Three of these are present on the fragment. They give rise to single low, broad, flexuous prorsiradiate ribs that strengthen across the flanks. Single long intercalated ribs arise low on the flanks and appear incipiently attached to a bulla in one instance. Some ribs bear a mid-lateral bulla; all ribs bear small rounded-feebly bullate inner ventrolateral tubercles, from which a broad rib sweeps forwards to a much stronger outer ventrolateral clavus. A broad, weakening rib extends from the clavi to form an obtuse ventral chevron, with a feeble siphonal clavus at the apex, the clavi borne on a feeble siphonal ridge, accentuated by crushing. Pervinquièrre's second specimen (1907, pl. 17, fig. 2; Pl. XIII, fig. 2 herein) and OUM KX1953 (Pl. XII, fig. 3) are larger phragmocone fragments, the latter a 180° whorl sector 83 mm in diameter. The umbilicus comprises 25.7% of the diameter. These are 7 primary ribs on the umbilical wall of the fragment that strengthen across the wall and link to strong bullae, perched on the umbilical shoulder. These give rise to pairs of ribs, which are coarse, straight and prorsiradiate across the flanks, and bear strong lateral and inner ventrolateral tubercles and strong outer ventrolateral clavi. Additional short ribs intercalate with inner and outer ventrolateral tubercles,

as on the primary ribs. The poorly preserved suture is deeply incised, with subphylloid folioles.

Discussion: The smaller specimen compares well with that from Devon England, figured by Wright & Kennedy (1987, pl. 42, fig. 6) at the same whorl height. The larger fragments correspond to the holotype of *Pseudacompsoceras vectense* Spath, 1925 (a synonym), refigured by Wright & Kennedy (1987, pl. 43, fig. 1). The presence of well-developed lateral tubercles distinguishes these specimens from strongly ribbed variants of *Acompsoceras renevieri*.

Occurrence: Lower Cenomanian, particularly the *dixoni* Zone, and extending into the lower Middle Cenomanian *inerme* Zone. There are records from Southern England, Haute-Normandie, Sarthe and Provence in France, Germany, Algeria, Central Tunisia, Madagascar, Texas in the USA, and northern Mexico.

Acompsoceras sp. juv.?

Pl. XXII, fig. 2

Material: OUM KX3173, from bed 8 of the section south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
OUM KX3173	46.7	18.5	24.2	0.76	10.5
	(100)	(39.6)	(51.8)		(22.5)

Description: The specimen is a 180° sector of phragmocone. Coiling is moderately involute, the umbilicus small, comprising 22.5% of the diameter, shallow, with a low, flattened, subvertical wall. The umbilical shoulder is quite narrowly rounded. The whorl section is compressed, with feebly convex flanks, the ventrolateral shoulders broadly rounded, the venter feebly convex. The costal whorl breadth to height ratio is 0.76. An estimated six small bullae perch on the umbilical shoulder. They give rise to single weak, straight, feebly prorsiradiate ribs, between which one or two long or short ribs intercalate, some of the long intercalatories feebly linked to a bulla. There are an estimated 13-14 ribs at the ventrolateral shoulder, where they bear weak inner ventrolateral bullae and stronger outer ventrolateral clavi. A broad rib links to a siphonal clavus, the venter obtusely fastigiate in costal section.

Discussion: The whorl section and ribbing suggest *Acompsoceras*, but the siphonal clavi are better developed than in most specimens, hence the qualified determination.

Occurrence: As for material.

Genus *Acanthoceras* Neumayr, 1875

Type species: *Ammonites rhotomagensis* Brongniart, 1822, pp. 83, 391, pl. 6, fig. 2, by the subsequent designation of de Grossouvre, 1894, p. 27.

Acanthoceras rhotomagense (Brongniart, 1822)

Pl. XIV, figs 5, 6, Pl. XVI, figs 8, 9

1822. *Ammonites rhotomagensis* Defr.– Brongniart, p. 83, 391, pl. 6, fig. 2.
1987. *Acanthoceras rhotomagense* (Brongniart, 1822).– Wright & Kennedy, p. 156, pl. 42, fig. 8, pl. 44, figs 1-11, pl. 45, figs 1-5, pl. 46, figs 1-4, 6, pl. 47, figs 1, 2, pl. 48, figs 1, 2, pl. 49, figs 1, 5, 6, text-figs 47-54, 63f-j, 64a, b, 65a-d, k, 66a, f, g, j, 67a-g, 68, 69 (with full synonymy).
1993. *Acanthoceras rhotomagense* (Brongniart, 1822).– Kennedy & Juignet, figs 1c, 10b, c, 11a-q, 12a-h, 13a-d, 14a-e, h, l, 15a, b, 16a-c, 17a, b.
1988. *Acanthoceras rhotomagense* (Brongniart).– Delamette, pl. 12, fig. 9.
1988. *Acanthoceras rhotomagense rhotomagense* (Brongniart, 1822).– Lehmann, fig. 7.
1988. *Acanthoceras rhotomagense subflexuosum* (Spath, 1923).– Lehmann, figs 8, 9.
1988. *Acanthoceras rhotomagense sussexiense* (Mantell, 1822).– Lehmann, figs 10, 11.
1991. *Acanthoceras rhotomagense* (Brongniart, 1822).– Delamette & Kennedy, p. 454, figs 15.12, 15.13.
1992. *Acanthoceras rhotomagense* (Brongniart, 1822).– Thomel, pl. 19, fig. 1, pl. 24, fig. 8, pl. 31, figs 1, 2, 6, 7, pl. 32; pl. 34, fig. 3.
1992. *Acanthoceras* gr. *rhotomagense* (Brongniart, 1822).– Thomel, pl. 24, fig. 3.
1993. *Acanthoceras rhotomagense* (Brongniart, 1822).– Kennedy & Juignet, figs 1c, 10b, c, 11a-q, 12a-h, 13a-d, 14a-e, h, l, 15a, b, 16a-c, 17a, b.
1993. *Acanthoceras rhotomagense* (Brongniart, 1822).– Matsumoto & Skwarko, p. 421, figs 11, 18b-d.
1994. *Acanthoceras rhotomagense* (Brongniart, 1822).– Kennedy, p. 22, pl. 7, figs 5, 6; pl. 8, figs 8, 9; pl. 10, figs 5, 6.
1994. *Acanthoceras rhotomagense* (Brongniart, 1822).– Amédro in Robaszynski *et al.*, p. 412, pl. 12, figs 3, 7, 8.
1998. *Acanthoceras rhotomagense* (Brongniart, 1822).– Kaplan *et al.*, p. 140, pl. 41, fig. 3, pl. 42, figs 1, 2, pls 43-46, pl. 47, figs 1-3, pl. 54, figs 1, 3, 4.
1999. *Acanthoceras rhotomagense* (Brongniart, 1822).– Hayakawa & Nishida, p. 8, pl. 11, fig. 9.
2010. *Acanthoceras rhotomagense* (Brongniart, 1822).– Amédro & Robaszynski, pl. 2, fig. 1, pl. 4, fig. 1.
2011. *Acanthoceras rhotomagense* (Brongniart, 1822).– Mosavina & Wilmsen, p. 184, figs 6a, b, 7a, b (with additional synonymy).

Type: Lectotype by subsequent designation by H. Douvillé (1912) is the original of Brongniart, 1822, pl. 6, fig. 2, an unregistered specimen in the Sorbonne Collections, from Rouen, Seine-Maritime, France. It was refigured by, amongst others, Wright & Kennedy (1987, text-fig. 63f-h).

Material: OUM KX1911, from the lower part or of bed 13, Foum el Guelta. OUM KX3219-24, from bed 10 south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
KX3219 c	46.1 (100)	25.6 (55.5)	23.7 (51.4)	1.1	8.8 (19.1)
KX3220 c	87.1 (100)	47.8 (54.9)	41.5 (47.7)	1.2	20.8 (23.9)

Description: OUM KX3219 (Pl. XVI, fig. 8) is a phragmocone just over 42 mm in diameter. Coiling is evolute, the umbilicus comprising 19.1% of the diameter, quite deep, with a feebly convex wall and broadly rounded umbilical shoulder. The flanks are flattened and subparallel in intercostal section, the ventrolateral shoulders broadly rounded, the venter flattened. Seven ribs per half whorl arise at the umbilical seam, and strengthen across the umbilical wall and shoulder, where they develop into small bullae. These give rise to narrow, straight, prorsiradiate ribs that strengthen across the flanks and link to rounded-conical inner ventrolateral tubercles. A broad, low rib projects forwards, and links to an outer ventrolateral clavus, the clavi are linked across the venter by a broad, transverse rib with a well-developed siphonal clavus. Secondary ribs separate successive primaries, some extending almost to the ventrolateral shoulder, with an outer flank, ventrolateral and ventral development comparable to that of the primary ribs. OUM KX3223 (Pl. XVI, fig. 9) a half whorl of phragmocone with a maximum preserved diameter of 85 mm, has a costal whorl breadth to height ratio of 1.1, the intercostal whorl section square, with rounded umbilical and ventrolateral shoulders, the costal section polygonal, with the greatest breadth at the umbilical bullae. There are 12 ribs on the half whorl, 11 primaries, and a single long intercalated rib towards the adapical end of the fragment. Primary ribs arise on the umbilical wall, and strengthen into small bullae. These give rise to single straight prorsiradiate ribs that broaden and strengthen across the flanks and link to rounded-conical inner ventrolateral tubercles, from which a broad rib links to outer ventrolateral and siphonal clavi, borne on a low, broad, transverse rib. OUM KX3220 (Pl. XIV, fig. 5), the largest specimen, retains a short section of body chamber, and has a maximum preserved diameter of 90 mm. There are 22 ribs per whorl, primary and intercalated ribs alternating on the adapical half of the outer whorl; all ribs are primaries on the adapertural half whorl. The flank ornament is as in previous specimens, the inner and outer ventrolateral tubercles linked by prorsiradiate ribs. The suture is deeply incised, with a broad bifid E/A, A narrow and bifid, and A/U2 narrow.

Discussion: *Acanthoceras rhotomagense* is succeeded by *Acanthoceras jukesbrownei* (Spath, 1926a) (see revision in Wright & Kennedy, 1987, p. 191, pl. 49, figs 2-4, pl. 50, figs 1-5, pl. 51, figs 1-7, text-figs 55-62, 64c, 65e, f, h-j, l, m, 66e, 67h-q), adults of which have few coarse, distant ribs with strong umbilical bullae, inner ventrolateral tubercles that decline to give a characteristic

trapezoidal rather than polygonal whorl section. Many such individuals have alternately long and short ribs that persist to maturity, a feature that readily distinguishes them from *A. rhotomagense*, but some specimens have the distinctive whorl section of *A. jukesbrownei* but lack persistent short ribs, so that the latter character cannot, of its own, be used to separate the two. Additional discussion is provided by Wright & Kennedy (1987, p. 155, 187).

Occurrence: Lower Middle Cenomanian. The species occurs in Western Europe from Northern Ireland through England, France from the Boulonnais to Provence, Switzerland, Germany, Bornholm in the Baltic, northern Spain, Romania, Dagestan, Turkmenistan and northern Iran, Algeria, Tunisia, New Guinea, Japan, and possibly Peru and Bathurst Island, northern Australia.

Genus *Cunningtoniceras* Collignon, 1937

Type species: *Ammonites cunningtoni* Sharpe, 1855, p. 35, pl. 15, fig. 2; by the original designation of Collignon 1937, p. 64 (40).

Discussion: Wright & Kennedy (1987, p. 193) diagnosed *Cunningtoniceras* as: "Derivatives of *Acanthoceras* with secondary ribs generally but not always confined to the venter: they are formed either by the splitting of the primaries or by intercalation; all the secondaries bear siphonal and commonly outer ventrolateral tubercles. Whorl section is quadrate to depressed. In later stages all ribs and tubercles except umbilical and fused ventrolateral may disappear and the ventrolateral tubercles extend sideways beyond the umbilical or obliquely upwards and may be excessively enlarged."

The detailed stratigraphic studies of Amédro *in Robaszynski et al.* (1994) in Tunisia, and Gale (1995) in Western Europe established that there is an interval characterised by *Cunningtoniceras inerme* and *C. cunningtoni* that occurs below the first occurrence of *Acanthoceras rhotomagense*, and an *inerme* Zone is now widely recognised as the lowest Zone of the Middle Cenomanian (see for example the Münster Basin, Germany: Kaplan *et al.*, 1998; Madagascar: Kennedy *et al.*, 2013; Walaszczyk *et al.*, 2014). *Acanthoceras* thus cannot be the ancestor of *Cunningtoniceras*, which preceded it. In contrast, the evidence from the material from Djebel Mrhila described below suggests the reverse to be the case. The evidence was already outlined by Pervinquier (1907, p. 280) in his description of a small specimen of his *Acanthoceras meridionale* var. *tuberculata*, figured as his pl. 15, fig. 5, re-illustrated here as Pl. XVI, fig. 1. As he notes "on voit que les tubercules ventraux sont d'abord allongés et en même nombre que les tubercules marginaux; du côté antérieur, ces tubercules sont subdivisés en deux tubercules arrondis." This transition is also seen even more distinctly in OUM KX15907 (Pl. XIV, fig. 4), a specimen described in detail under *C. inerme* below. All the ribs are primaries to the greatest preserved diameter of 50 mm. The adapical

three have a simple rib and tubercle arrangement with a single umbilical, inner and outer ventrolateral and siphonal tubercle on each rib (Pl. XIV, fig. 4c). The fourth rib has an incipient doubling of the rib between the outer ventrolateral tubercles, the adapical one with a well-developed siphonal tubercle, whilst the succeeding four ribs have a pair of ribs linking the outer ventrolateral tubercles, each bearing a siphonal tubercle (Pl. XIV, fig. 4a). A typically *Acanthoceras* morphology is thus succeeded by a typical *Cunningtoniceras* one, and we conclude that *Acanthoceras* is a paedomorphic derivative of *Cunningtoniceras*: the juvenile ornament of *Cunningtoniceras* persists to maturity in *Acanthoceras*. On this basis we refer a number of juvenile acanthoceratines that co-occur with *Cunningtoniceras* in the Djebel Mrhila sections to *Cunningtoniceras* spp. juv. (Pl. XIV, figs 1, 3). They differ from juvenile *Acanthoceras rhotomagense* on the same size in having a depressed whorl section, and all, or the overwhelming majority of the ribs bullate primaries, whereas primary and intercalated ribs alternate in *rhotomagense* to diameters of 40 mm in depressed individuals (Wright & Kennedy, 1984, p. 187). Recognition of this early ontogeny of *Cunningtoniceras* clarifies the record of *Calycoceras* (*Newboldiceras*) in association with *Mantelliceras* in the Oued Smarna section in the environs of Kalaat Senan, 80 km to the northwest of the present sections (Amédro *in Robaszynski et al.*, 1994, p. 412 et seq, pl. 12, figs 12-14, text-fig. 29). We suggest they may in part be juvenile *Cunningtoniceras*.

There is no agreement over species limits in *Cunningtoniceras*. Wright & Kennedy (1987) drew their species limits very widely, recognizing only two in the British fauna; others have drawn species limits more narrowly, or recognised subspecies within a variable *C. cunningtoni* (Zaborski, 1985).

Two groups can be recognised within the genus: The group of *C. cunningtoni sensu stricto*, where there are fewer outer ventrolateral than siphonal tubercles, and the group of *C. meridionale* (Stoliczka, 1864) where there are equal numbers of outer ventrolateral and siphonal tubercles. Kennedy (1971) regarded *meridionale* as a variety of *cunningtoni*; Cooper (1973) as a subspecies; Howarth (1985) as a variety; Wright & Kennedy (1987) as a synonym; Matsumoto *et al.* (1989) as a separate species. We have seen over 40 mainly fragmentary *Cunningtoniceras* from Djebel Mrhila, and find ourselves undecided as to which of the above conclusions is correct. Accordingly, we adopt a narrow, typological approach and recognise four species, with further specimens left in open nomenclature.

***Cunningtoniceras inerme* (Pervinquier, 1907)**

Pl. XIV, fig. 4, Pl. XV, fig. 1, Pl. XVI, fig. 7,
Pl. XVII, fig. 1, Pl. XX, fig. 1

1855. *Ammonites sussexiensis* Mantell.– Sharpe, p. 34, pl. 15, fig. 1.

1907. *Acanthoceras Cunningtoni* var. *inermis* Pervinquierè, p. 277.
1985. *Euomphaloceras inerme* (Pervinquierè, 1907).– Zaborski, p. 40, fig. 44.
1985. *Euomphaloceras cunningtoni meridionale* (Stoliczka).– Zaborski, p. 43 (*pars*), fig. 43 only.
1987. *Cunningtoniceras inerme* (Pervinquierè, 1907).– Wright & Kennedy, p. 194, pl. 52, fig. 1, pl. 53, fig. 6, text-figs 74, 75, 79 (with full synonymy).
1994. *Cunningtoniceras inerme* (Pervinquierè, 1907).– Amédro in Robaszynski *et al.*, p. 412, pl. 13, fig. 6.
1998. *Cunningtoniceras inerme* (Pervinquierè, 1907).– Kaplan *et al.*, p. 148, pl. 48, figs 1, 2, pl. 55, figs 1-5, pl. 56, figs 1-4 (with additional synonymy).
2010. *Cunningtoniceras inerme* (Pervinquierè, 1907).– Amédro & Robaszynski, pl. 5, fig. 1.

Type: The holotype, by monotypy, is no. 7754 in the collections of the British Geological Survey, the original of Sharpe, 1855, pl. 15, fig. 1, refigured by Wright & Kennedy, 1987, pl. 52, fig. 1, text-fig. 74, from the Lower Chalk of Lewes, East Sussex, England.

Material: OUM KX15907, from bed 9 of the section south of Sif et Tella; OUM KX3194-6, 3204-7, KX3214, and ?KX3208, from bed 10 of the Sif et Tella section.

Description: OUM KX15907 (Pl. XIV, fig. 4) is a well-preserved half whorl with a maximum diameter of 50 mm. The intercostal whorl section is depressed, with convex flanks, broadly rounded ventrolateral shoulders and a broad, very feebly convex venter. Seven primary ribs are preserved on the fragment. They arise on the umbilical wall and strengthen into sharp, widely separated bullae, perched on the umbilical shoulder. These give rise to widely separated narrow, straight, rectiradiate ribs that link to strong pinched inner ventrolateral bullae. The three adapical ribs give rise to a single transverse rib that links to a rounded to feebly clavate outer ventrolateral tubercle and a siphonal clavus. The siphonal region of the fourth rib is damaged, but there is a suggestion of a pair of poorly differentiated ribs linking single outer ventrolateral and siphonal clavi. The fifth to seventh ribs have outer ventrolateral clavi linked by a pair of transverse ribs, the adapical with a small, slightly transversely elongate siphonal tubercle, the adapertural with a slightly stronger, conical tubercle. OUM KX3207 (Pl. XVI, fig. 7), 58 mm in diameter, although less well-preserved, show a comparable transition from a single rib to a pair of ribs bearing siphonal tubercles linking the outer ventrolateral tubercles across the venter, although differing in details. OUM KX3204 (Pl. XV, fig. 1) is a 120° whorl sector of phragmocone with a maximum preserved whorl height of 26 mm. There are five primary ribs on the fragment, with weak umbilical bullae, strong conical inner ventrolateral tubercles and weaker outer ventrolateral clavi, linked across the venter by pairs of ribs, each with a feebly bullate siphonal tubercle. A short intercalated rib, restricted to the venter, separates the successive primary rib groups, and bears a similar siphonal tubercle.

OUM KX3208 (Pl. XX, fig. 1) is a half whorl of phragmocone with a maximum preserved diameter of 60 mm. There are seven umbilical bullae and 12 ribs on the flanks of the fragment, most of the ribs arising singly from the bullae, with a single pair arising from a bulla, plus occasional intercalated ribs. On the venter of most of the fragment, a single broad transverse rib links conical inner ventrolateral tubercles to outer ventrolateral and siphonal clavi; in contrast, the adapertural three flank ribs have pairs of ventral ribs with siphonal tubercles linking a single outer ventrolateral clavus.

OUM KX3205 (Pl. XVII, fig. 1) is an internal mould of a 60° whorl sector of a phragmocone with a maximum preserved whorl height of 43 mm. The intercostal whorl section is rounded-rectangular. The costal whorl section is trapezoidal-polygonal, with a whorl breadth to height ratio of 1.25, the greatest breadth at the umbilical bullae. Coiling is evolute, the umbilicus quite deep, with a feebly convex vertical wall and broadly rounded umbilical shoulder. There are five primary ribs on the fragment. They arise at the umbilical seam and strengthen across the umbilical wall, linking to a weak umbilical bulla. The ribs are straight and prorsiradiate, strengthening across the flanks and linking to a conical inner ventrolateral tubercle. A low, broad, wedge-shaped transverse rib connects to a blunt outer ventrolateral clavus. The clavi are linked across the venter by a pair of ribs or a single rib, with a weak siphonal bulla. The suture is quite deeply incised, with deep E, very broad, bifid E/A, smaller A and U2.

OUM KX3195-6 are large phragmocone fragments of comparable size and whorl section, without, however, intercalated ventral ribs, OUM KX3194 is a phragmocone fragment with a maximum preserved whorl height of 50 mm; all three correspond to the holotype at the same size.

Discussion: The present material is referred to *C. inerme* on the basis of the rectangular whorl section, relatively weak umbilical tuberculation, equal number of inner and outer ventrolateral tubercles, the latter linked by pair of ribs in early ontogeny but only a single rib thereafter. OUM KX3205 is more closely ribbed than the holotype, but compares well with the Nigerian example figured by Zaborski (1984, text-fig. 44). Amongst described species, *C. cunningtoni* most closely resembles *C. inerme* (Pervinquierè, 1907) (see revision in Wright & Kennedy, 1987, p. 194, pl. 52, fig. 1, pl. 53, fig. 6, text-figs 74, 75, 79). They differ, in the higher primary rib density of *inerme* (20 versus 10-13 per whorl), the disappearance of multiple ventral ribs and tubercles abruptly at a relatively early ontogenetic stage, followed by one in which primary ribs bear umbilical bullae, conical inner, and clavate outer ventrolateral tubercles, the latter linked across the venter by a transverse rib with an effacing siphonal clavus. *Cunningtoniceras meridionale*, described below, differs from the present species in having equal numbers of outer ventrolateral and siphonal tubercles on all ventral ribs, as discussed above.

Occurrence: Lower Middle Cenomanian, index of the *inerme* Zone. The species is known from southern England, Sarthe and Provence in France, Switzerland, Germany, Turkmenistan, Morocco, Central Tunisia, Hokkaido, Japan, and Texas in the United States.

***Cunningtoniceras meridionale* (Stoliczka, 1864)**

Pl. XV, fig. 3, Pl. XVI, figs 1, 5, Fig. 22A

1864. *Ammonites meridionalis* Stoliczka, p. 76, pl. 41, fig. 1.
 1907. *Acanthoceras meridionale* var. *tuberculata* Pervinquierè, p. 280, pl. 15, figs 5, 6.
 1957. *Euomphaloceras* (*Acanthoceras*)? sp. indet. Matsumoto *et al.*, p. 35 (*pars*), pl. 18, fig. 1 only.
 1963. *Euomphaloceras cunningtoni meridionale* (Stoliczka).—Wright, p. 608, pl. 89, fig. 1.
 1967. *Euomphaloceras lehmanni* Collignon, p. 28, pl. 13, figs 1, 2.
 1969. *Euomphaloceras meridionale* (Stoliczka).—Matsumoto *et al.*, p. 272, pl. 33, figs 1, 2, pl. 34, fig. 1, text-fig. 6.
 1971. *Euomphaloceras cunningtoni meridionale* (Stoliczka).—Kennedy, p. 93.
 1973. *Euomphaloceras cunningtoni meridionale* (Stoliczka).—Cooper, p. 61, figs 10a, b, 11, 12a, b, 13a.
 non 1981. *Euomphaloceras* cf. *cunningtoni tuberculata* (Pervinquierè).—Amédéo, Berthou & Lauverjat, p. 156, pl. 1, fig. 2 [= *Euomphaloceras septemseriatum* (Cragin, 1893)].
 1985. *Euomphaloceras* (*Euomphaloceras*) *cunningtoni* (Sharpe) var. *meridionale* (Stoliczka).—Howarth, p. 93, figs 22, 24.
 1985. *Euomphaloceras cunningtoni meridionale* (Stoliczka).—Zaborski, p. 43 (*pars*), figs 45, 46 (non fig. 43 = *C. inerme*).
 1985. *Euomphaloceras cunningtoni cunningtoni* (Sharpe).—Zaborski, p. 45, figs 47-52.
 ?1985. *Euomphaloceras cunningtoni alatum* Zaborski, p. 49, figs 53-56.
 1989. *Cunningtoniceras meridionale* (Stoliczka).—Matsumoto *et al.*, p. 39, figs 7-9.
 1999. *Cunningtoniceras cunningtoni* (Sharpe, 1855).—Hayakawa & Nishida, p. 8, pl. 11, figs a-g, pl. 12, figs a-c.
 2011. *Cunningtoniceras cunningtoni* (Sharpe, 1855).—Mosavina & Wilmsen, p. 184, figs 6a, b, 7a, b.

Type: The lectotype, by the subsequent designation of Matsumoto *et al.*, 1969, p. 272, is the original of Stoliczka, 1864, p. 76, pl. 41, fig. 1, no. 175 in the collections of the Indian Geological Survey, Kolkata, from the Utatur Group of Odium, South India.

Material: Two unregistered specimens in the Flick Collection, housed in the Sorbonne Collections, the originals of *Acanthoceras meridionale* var. *tuberculata* Pervinquierè, 1907, p. 280, pl. 15, figs 5, 6, from Foug el Guelta and Djebel Sidi bou Goubrine respectively. OUM KX1385 and KX3121, from bed 8 south of Sif et Tella.

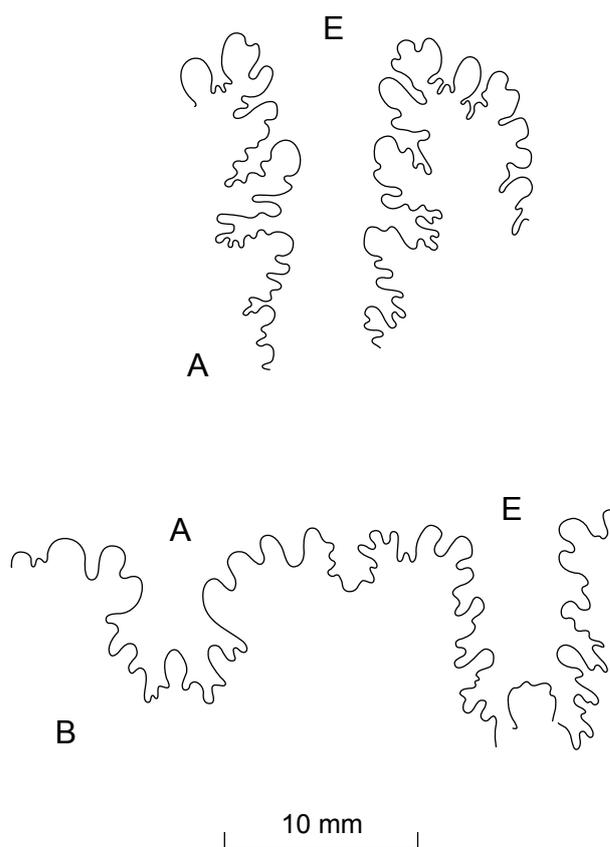


Fig. 22: Partial external suture lines. A: *Cunningtoniceras meridionale* (Stoliczka, 1864), from an unregistered specimen in the Sorbonne Collections, the original of Pervinquierè, 1907, pl. 15, fig. 6 (Pl. XV, fig. 3 herein). B: *Pseudocalycoceras haugi* (Pervinquierè, 1907), from an unregistered fragment, a syntype specimen in the Sorbonne Collections, mentioned by Pervinquierè, 1907, p. 271 (Pl. XX, fig. 2 herein).

OUM KX15912, from bed 13, Foug el Guelta, may also belong here.

Description: The earliest growth stage referred to the species is the original of Pervinquierè's smaller specimen of *Acanthoceras meridionale* var. *tuberculata* (1907, pl. 15, fig. 5; Pl. XVI, fig. 1 herein). It is an internal mould of a 180° sector of phragmocone with a maximum preserved diameter of 36.8 mm. The umbilicus is deep, comprising 28% of the diameter, with a feebly convex wall and broadly rounded umbilical shoulder. The whorl section is depressed, with a costal whorl breadth to height ratio of 1.3, the greatest breadth at the umbilical tubercles. Nine primary ribs arise at the umbilical seam, and are strong and rounded on the umbilical wall, strengthening into sharp to subspinose umbilical bullae. These give rise to single straight coarse prorsiradiate ribs, weakened at mid-flank, and leading to sharp conical subspinose inner ventrolateral tubercles. On the four adapical ribs, these give rise to a single transverse rib, with a weaker conical outer ventrolateral tubercle and a feebly clavate siphonal tubercle. Between the fourth

and fifth primary ribs, a single rib intercalates around mid-flank, with an incipient inner ventrolateral bulla, a transversely elongated outer ventrolateral tubercle, and a conical siphonal tubercle. The inner ventrolateral tubercles on the succeeding two primaries give rise to a pair of ribs with well-developed outer ventrolateral and siphonal clavi. Pervinquière's larger specimen (1907, pl. 15, fig. 6; Pl. X, fig. 3 herein), is a 120° whorl sector of a somewhat distorted composite mould 52 mm long, with a maximum preserved whorl height of 20.2 mm. The coiling is very evolute, the umbilicus deep, with a flattened wall and broadly rounded umbilical shoulder. The whorl section is depressed, rounded-trapezoidal in intercostal section, and polygonal in costal section, with the greatest breadth at the umbilical bullae; the costal whorl breadth to height ratio is 1.7, a figure increased by distortion of the mould. Six primary ribs are present on the fragment. They arise at the umbilical seam, and are strong, rounded, and projected slightly forwards on the umbilical wall, strengthening into spinose umbilical bullae, from which a broad, strong, straight prorsiradiate rib links to a massive conical inner ventrolateral tubercle. These tubercles give rise to pairs of low, broad ribs, the adapical one transverse, the adapertural one projected markedly forwards, and linked in each case to a straight, transverse ventral rib with coarse, equal, rounded to feebly clavate outer ventrolateral and siphonal tubercles, giving a total of twice as many ventral as flank ribs.

OUM KX 1385 (Pl. XVI, fig. 5) is interpreted as a fragmentary microconch. It is a 120° whorl sector consisting of a single camera and the adapical part of the body chamber. The intercostal whorl section is depressed, rounded-rectangular, with a whorl breadth to height ratio of 1.4 approximately, the flanks feebly convex, subparallel, the ventrolateral shoulders broadly rounded, the venter flattened. Parts of four ribs are preserved. Coarse and distant on the umbilical wall, they strengthen into large umbilicolateral bullae, from which a low, broad rib connects to a massive outwards and slightly upwards directed inner ventrolateral horn. A broad wedge-shaped rib with a median depression extends across the outer part of the venter, the raised adapical edge linked to a small rounded outer ventrolateral tubercle. The adapertural edge is differentiated into a distinct ridge, not apparently linked to a tubercle but preservation is poor. OUM KX3121 is a larger, worn fragment, with a maximum preserved intercostal whorl height of 37 mm approximately, with comparable ornament, the inner ventrolateral horns linked across the venter by a broad wedge-shaped rib with a median depression that differentiates its margins into a pair of ribs.

Discussion: A distinctive features of the larger specimen of Pervinquière's var. *tuberculatum* is the presence of small outer ventrolateral tubercles on all ventral ribs. This is a feature that links it to *C. meridionale*, and Matsumoto *et al.* (1969, p. 272; 1989, p. 42) regarded it (and indeed Pervinquière's var. *africana*) as a possible synonym.

If the presence of outer ventrolateral tubercles on all ventral ribs is used as a criterion for specific distinction then the *Cunningtoniceras cunningtoni* of Zaborski (1985, p. 45, figs 47-52, including *alatum* Zaborski, 1985, p. 49, figs 53-56) belong here. *Euomphaloceras lehmanni* (Collignon, 1967, pp. 28, 29, pl. 13, figs 1, 2), has comparable ventral tuberculation, and appears to be a further synonym. Specimens from the Koppeh Dag in northern Iran figured by Mosavina & Wilmsen (2011) have equal numbers of outer ventrolateral and siphonal tubercles, and also belong here.

The presence of outer ventrolateral tubercles on all ventral ribs distinguishes *C. meridionale* from *C. inerme*, *C. cunningtoni*, and *C. africanum*.

Occurrence: Lower Middle Cenomanian, south India, Hokkaido, Japan, Iran, Morocco, Central Tunisia, Nigeria, and Angola.

***Cunningtoniceras africanum* (Pervinquière, 1907)**

Pl. XV, figs 2, 4, 5, 6, Pl. XVI, figs 4, 6, Pl. XVII, fig. 2, Figs 23, 24

1903. *Acanthoceras* cf. *cunningtoni* Sharpe.— Pervinquière, p. 67.
 1907. *Acanthoceras meridionale* Stoliczka var. *Africana* Pervinquière, p. 279 (*pars*), pl. 15, figs 3, 4 (*non 2*, = *Lotzeites elegans* sp. nov.), text-fig. 106.
 1907. *Acanthoceras cunningtoni* Sharpe.— Pervinquière, p. 277, pl. 15, fig. 1.
 1944. *Cunningtoniceras höltkeri* Erni, p. 470, pl. 11, figs a-c.
 1987. *Cunningtoniceras* sp. Wright & Kennedy, p. 195, pl. 53, figs 5, 7.

Types: The lectotype, here designated, is an unregistered specimen in the Sorbonne Collections, *ex* Flick Collection, the original of Pervinquière, 1907, pl. 15, fig. 3, from Kef Si Abd el Kader (Pl. XV, fig. 5). There are two figured paralectotypes, the original of Pervinquière, 1907, pl. 15, fig. 4 (Pl. XV, fig. 6), and his pl. 15, fig. 2 (Pl. XVI, fig. 2), the latter the holotype of *Lotzeites elegans* sp. nov., described below, also in the Sorbonne Collections, and from Fom el Guelta.

Material: OUM KX15906 and 2033, from bed 9, Fom el Guelta. OUM KX 3169 from bed 8, KX3209, 3211, 3212, and 3214 from bed 10, south of Sif et Tella.

Description: The lectotype, the original of Pervinquière, 1907, pl. 15, fig. 3 (Pl. XV, fig. 5) is a very well-preserved 90° sector from the adapertural end of the phragmocone, with a maximum preserved costal whorl height of 40 mm. Coiling is evolute, the umbilicus deep, with a feebly convex outward-inclined wall and broadly rounded umbilical shoulder. The intercostal whorl section is rounded-trapezoidal, with a whorl breadth to height ratio of 1.34, the greatest breadth just outside the umbilical shoulder, the flanks very feebly convex, convergent, the ventrolateral shoulders broadly rounded, the venter very broad and flattened. The costal whorl section is depressed rectangular-trapezoidal, the greatest



Fig. 23: *Cunningtoniceras africanum* (Pervinquièrre, 1907), copy of Pervinquièrre, 1907, pl. 15, fig. 1, of a specimen from Foum el Guelta (the original has not been traced).

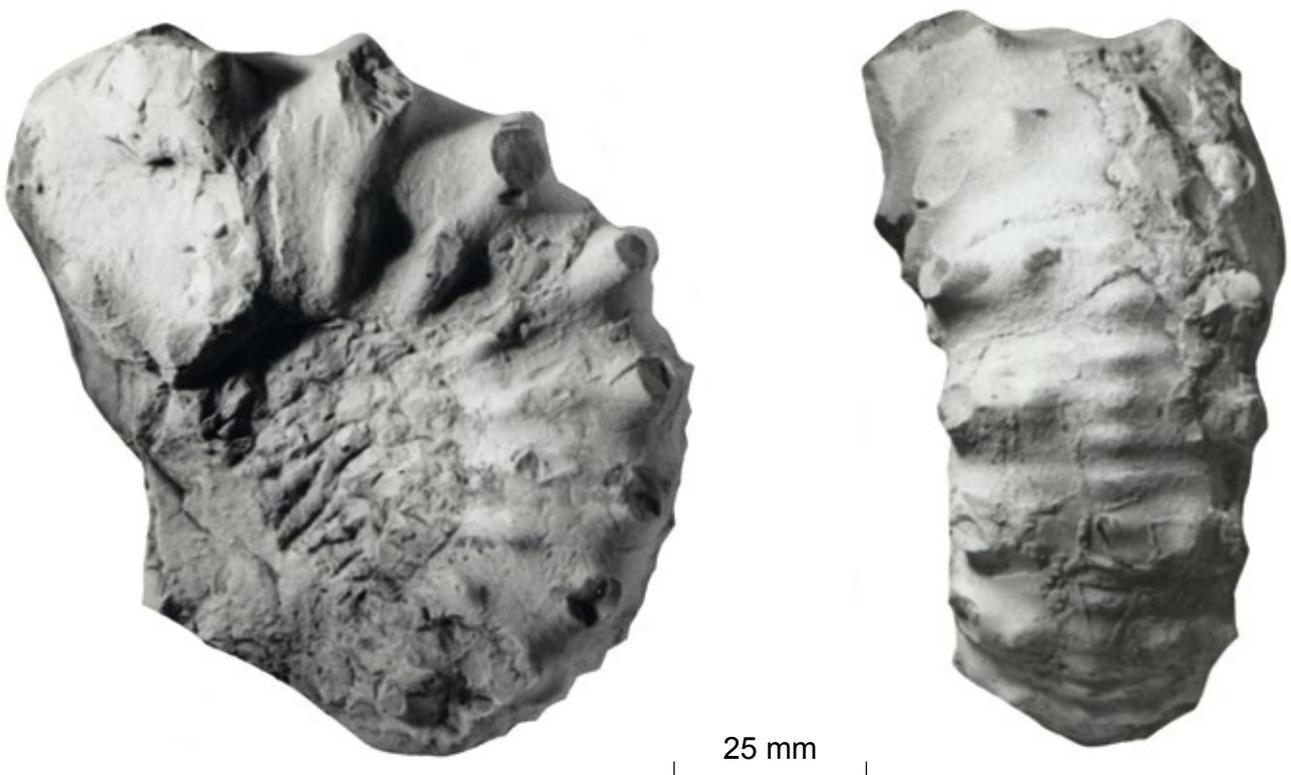


Fig. 24: *Cunningtoniceras africanum* (Pervinquièrre, 1907). The holotype of *Cunningtoniceras hoeltkeri* Emi, 1945, p. 470, pl. 11, figs 1-3, from central New Guinea, no. J33243 in the collections of the Naturhistorisches Museum, Basel.

breadth at the umbilical tubercle, the whorl breadth to height ratio 1.48. The ornament of the penultimate whorl is partially preserved on the unfigured side: strong ribs are present on the umbilical wall, and strengthen into sharp umbilical bullae that give rise to single strong, straight prorsiradiate primary ribs. Four primary ribs are present on the outer whorl fragment. They arise at the umbilical seam, and are weak on the inner part of the umbilical wall but strengthen on the outer, where they are coarse, narrower than the interspaces, and develop into strong, sharp umbilical bullae. These give rise to single coarse, broad, straight, prorsiradiate ribs that are distinctly narrower than the interspaces. The ribs strengthen into massive bullate inner ventrolateral tubercles; all are damaged, but when complete may have had the form of outward-directed short horns. Three of these tubercles give rise to a pair of low, broad ribs, the adapical one transverse, the adapertural one projected forwards and convex on the ventrolateral shoulder and crossing the venter in a shallow convexity. At the adapical end of the fragment there are the feeblest indications of an outer ventrolateral tubercle, but no evidence on the other ribs for outer ventrolateral or siphonal tubercles. There is an intercalated ventral rib between the looped ribs associated with the second and third looped pair. The suture is deeply incised, with a large asymmetrically bifid E/A, narrower A, and smaller U2. The ornament at the adapertural end of this paralectotype fragment corresponds to that at the adapical end of the lectotype, illustrated here as Pl. XV, fig. 6. This is a well-preserved internal mould of just under half a whorl, with a maximum preserved diameter of 128 mm. All but the section bearing the adapertural two ribs is phragmocone; the last two septa clearly interfere, and the specimen is interpreted as an incomplete adult macroconch. Coiling is very evolute, the umbilicus of moderate depth, the umbilical wall concave, the umbilical seam notched to accommodate the inner ventrolateral tubercles of the penultimate whorl. The umbilical shoulder is in consequence relatively narrowly rounded. The whorl section is depressed, with an intercostal whorl breadth to height ratio of 1.28, the intercostal whorl section rounded-trapezoidal, with feebly convex convergent flanks, broadly rounded ventrolateral shoulders and a broad, flattened venter. The costal whorl section is trapezoidal-polygonal, with the greatest breadth at the very strong umbilical bullae; the costal whorl breadth to height ratio is 1.5. Six primary ribs are present on the fragment. They are very strong and coarse, and separated by very wide interspaces. The inner, concave part of the umbilical wall is smooth, the ribs arising on the umbilical shoulder, and developing into very strong umbilical bullae. They are recti-to feebly rursiradiate on the flanks, and link to strong ventrolateral bullae, the rib profile concave on the flanks in costal section. At the adapical end, the ventrolateral bulla on the first rib gives rise to two ribs, the adapical one transverse, the adapical one feebly convex. The rib is

strengthened over the siphonal line, but there is no clearly differentiated siphonal tubercle. The ventrolateral bullae of the succeeding ribs are all linked across the venter by a single coarse transverse rib, the rib profile feebly concave in costal section. E/A is broad and bifid, A bifid. Both of these specimens are interpreted as fragments of macroconchs.

A series of fragments link juveniles with whorl heights of as little as 19 mm to Pervinquière's large specimens: OUM KX3209 (Pl. XVI, fig. 4) with a whorl height of 29 mm, has a very depressed whorl section, the intercostal whorl breadth to height ratio 1.45 approximately, the costal ratio 1.54, the greatest breadth at the umbilical bullae. There are three primary ribs on the fragment. Strong umbilical bullae give rise to broad straight prorsiradiate ribs that link to strong, outwards-directed bullate inner ventrolateral horns. Eight ventral ribs are present. One rib, corresponding to an inner ventrolateral horn bears a small rounded outer ventrolateral and siphonal tubercle. A second, adapertural rib is also linked to an inner ventrolateral horn, and bears a weak siphonal tubercle. An intercalated rib with feebler outer ventrolateral and siphonal tubercle separates looped rib pairs, although the overall pattern is irregular.

OUM KX3169 (Pl. XV, fig. 2) is a largely complete phragmocone 53 mm in diameter. The ornament is coarse and crowded, with eight umbilical bullae per half whorl and coarse inner ventrolateral horns, linked across the venter by pairs of coarse ribs, one with a well-developed outer ventrolateral and siphonal tubercle the other with a siphonal tubercle and no, or only an incipient outer ventrolateral bulla. Single short ribs intercalate between successive looped pairs, and have a weak, or no siphonal tubercle. This same pattern is shown by OUM KX 3214 (Pl. XVI, fig. 6), a coarsely ribbed variant.

OUM KX3211 (Pl. XVII, fig. 2) is a 120° whorl sector of phragmocone, with a maximum preserved whorl height of 35.5 mm. The costal whorl breadth to height ratio is 1.39. There are five primary ribs on the fragment, with strong umbilical bullae and massive inner ventrolateral horns, as in the previous specimens. The ventral ornament is in contrast, much weaker and delicate. The outer ventrolateral horns are linked by a pair of looped ribs, as previously, but much weaker, one with a weak rounded to feebly clavate outer ventrolateral tubercle, the siphonal tubercle weaker still. The other looped rib and the intercalated ribs lack an outer ventrolateral tubercle.

OUM KX2033 (Pl. XV, fig. 4) is interpreted as a microconch of the species. It has a maximum preserved diameter of 78 mm, and retains just under half a whorl of body chamber. The final two sutures interfere; this and the ontogenetic changes in the ornament indicate it to be an incomplete adult. Coiling is very evolute, the umbilicus comprising 33% of the diameter, deep, with a convex outward-inclined wall and broadly rounded umbilical shoulder. The intercostal whorl section is depressed rounded-trapezoidal, with a whorl breadth to

height ratio of 1.38. The adapical half of the penultimate whorl bears six to seven primary ribs that arise at the umbilical seam, strengthen across the umbilical wall and shoulder, developing into sharp umbilical bullae that give rise to progressively strengthening straight, prorsiradiate primary ribs. Parts of six ribs are preserved on the fragment. They are much narrower than the interspaces. The second rib from the adapical end of the fragment bears a massive inner ventrolateral horn that gives rise to a pair of ribs that loop across the venter, the adapical one transverse, the adapertural one feebly convex on the ventrolateral shoulder and crossing the venter in a very feeble convexity. The succeeding ribs bear progressively weakening ventrolateral tubercles, the last two with little more than a rounded-angular ventrolateral shoulder, linked across the venter by a strong, straight, transverse rib, with the faintest indications of a median depression, a relic of the pair of ribs linking the adapicalmost ventrolateral horns.

Discussion: Pervinquière (1907, pl. 15, fig. 1, reproduced here as Fig. 23) figured a near-complete phragmocone in the Flick Collection from Foum el Guelta that we have not traced. It is the holotype, by monotypy of *Cunningtoniceras pervinquieri* (Collignon, 1967) (p. 29) (Collignon introduced his *Euomphaloceras euomphalum* var. *pervinquieri* in 1964, p. 145, and refers to his Cephalopodes de Tarfaya, which did not appear until 1967). The specimen is 67 mm in diameter according to Pervinquière; the siphonal tuberculation is described as follows (Pervinquière, 1907, p. 277). "Sur notre échantillon, les tubercules médians sont arrondis et bien distincts, les uns des autres; toutefois, dans l'âge adulte, ces tubercules tendent à se fondre en une carène continue très légère, qui disparaît d'ailleurs dans la vieillesse, tandis que les petites côtes ventrales s'effacent." The specimen is not, however adult; a suture is visible just adapically of the final rib, and only a short sector is body chamber. The changes in ornament described by Pervinquière are not seen in the holotype of *cunningtoni*, and distinguish it from that species.

Cunningtoniceras hoeltkeri Erni, 1945 (p. 470, pl. 11, figs 1-3) from central New Guinea is a synonym of *africanum*. The holotype, no. J33243 in the collections of the Naturhistorisches Museum, Basel, is illustrated here as Fig. 24. It is preserved in a brown ironstone nodule, and is a 240° whorl sector with a maximum preserved diameter of 103 mm, consisting of two camerae and the body chamber, retaining traces of the original aragonitic shell. Parts of 11 ribs are preserved on the specimen, all primaries that arise at the umbilical seam, strengthen across the umbilical wall and shoulder and link to progressively strengthening umbilical bullae. These give rise to straight prorsiradiate ribs that strengthen across the flanks and link to strong conical inner ventrolateral horns, linked by a broad rib to weaker outer ventrolateral clavi. These are linked across the venter by pairs of ribs with a weak transversely elongated siphonal tubercle.

Additional ventral ribs intercalate, bearing only a siphonal tubercle. The siphonal tubercles weaken progressively on the adapertural part of the body chamber.

The *Cunningtoniceras* sp. of Wright & Kennedy (1987, p. 195, pl. 53, figs 5, 7) from Wilmington in Devon is a further synonym of *africanum*.

Occurrence: Lower Middle Cenomanian, Central Tunisia, adjacent parts of eastern Algeria, New Guinea, and Devon, England.

Cunningtoniceras? sp.

Pl. XVII, figs 3, 4

Material: OUM KX 3198-99, from bed 10, south of Sif et Tella.

Description: OUM KX3199 (Pl. XVII, fig. 3) is a 180° sector of phragmocone 95 mm in diameter, with a maximum preserved whorl height of 51 mm. Coiling is evolute, the deep umbilicus comprising 24% of the diameter, with a high, feebly convex vertical umbilical wall, the umbilical shoulder broadly rounded. The intercostal whorl section is depressed, with a whorl breadth to height ratio of 1.37, the flanks convex, the ventrolateral shoulders broadly rounded, the venter very broad and flattened. The costal whorl section is trapezoidal-polygonal with the greatest breadth at the umbilical bullae, the whorl breadth to height ratio 1.35. There are 10 primary ribs on the outer half whorl that arise at the umbilical seam and strengthen across the umbilical wall and shoulder, developing into small bullae, displaced slightly outwards from the umbilical shoulder. The bullae give rise to a broadening feebly prorsiradiate rib that connects to a strong conical inner ventrolateral tubercle. A broad wedge-shaped rib connects to a strong outer ventrolateral clavus. There is a blunt siphonal ridge, strengthened between the outer ventrolateral clavi in many, but not all cases, differentiated into a pair of conical siphonal tubercles. OUM KX3198 (Pl. XVII, fig. 4) is 119 mm in diameter, and retains a 120° sector of body chamber. The whorls are massive, as in the previous specimen, with a costal whorl breadth to height ratio of 1.29, the greatest breadth at the umbilical bullae. There are 10 primary ribs on the adapertural half of the outer whorl, with umbilical bullae, flank ribs, and inner ventrolateral tubercles as in the previous specimen. The inner ventrolateral tubercles are connected by a broad wedge-shaped rib to a blunt outer siphonal clavus; a single siphonal clavus corresponds to each outer ventrolateral.

Discussion: These specimens are linked by their massive whorl section and flank ornament. But for the presence of two siphonal tubercles corresponding to a single outer ventrolateral clavus on some but not all ribs in OUM KX3199, they would be referred to *Acanthoceras*. The material is poor, and is accordingly left in open nomenclature.

Occurrence: As for material.

***Cunningtoniceras* spp. juv?**

Pl. XIV, figs 1, 3

Material: OUM KX2003-6, from bed 9(?), Foug el Guelta. OUM KX1383-4, 3170-72, 3174, 3180-81 from bed 8 south of the Sif et Tella.

Description: OUM KX3180 (Pl. XIV, fig. 1) is typical of the smaller specimens, with a maximum preserved diameter of 37 mm. The umbilicus is small and deep, the whorl section depressed, with a whorl breadth to height ratio of 1.6 in costal section, the section polygonal, with the greatest breadth at the umbilicolateral tubercle. There are an estimated 10 ribs per half whorl. Primaries are strong and narrow on the umbilical wall and shoulder, and strengthen into strong, sharp bullae, displaced outwards from the umbilical shoulder to an umbilicolateral position. Intercalated ribs arise around mid-flank. The ribs are straight and prorsiradiate, and all bear sharp bullate inner ventrolateral tubercles, linked by a broad rib to strong outer ventrolateral clavi. A feeble, effaced rib connects across the venter, and links to a subequal siphonal clavus. OUM KX3170 (Pl. XIV, fig. 3) is a crushed and deformed 120° whorl sector. The whorl section is very depressed, with a costal whorl breadth to height ratio of 1.6. There are parts of nine ribs on the fragment, all primaries, strong, straight, and prorsiradiate on the flanks, and passing straight across the venter. They bear umbilicolateral bullae of variable strength, stronger conical-bullate inner ventrolateral tubercles, and strong subequal outer ventrolateral and siphonal clavi.

Discussion: These small specimens are regarded as juvenile *Cunningtoniceras* that have not reached the stage where multiple ventral ribbing and tuberculation appears on the basis of the presence of this early *Acanthoceras*-like growth stage in the smaller specimen of Pervinquière's *Acanthoceras meridionale* var. *tuberculatum* (Pl. XVI, fig. 1) as well as specimens here referred to *C. inerme* (Pl. XIV, fig. 4).

Occurrence: As for material.

***Cunningtoniceras tinrhertense* (Collignon, 1965)**

Pl. XVIII, figs 1-3, Figs 25, 26

1965. *Kamerunoceras tinrhertense* Collignon, p. 175, pl. D.

non 1985. *Kamerunoceras tinrhertense* Collignon, 1965.–Zaborski, p. 51, text-figs 57-59 (?= *Kamerunoceras* sp.).

1996. *Cunningtoniceras tinrhertense* (Collignon, 1965).–Amédéo *et al.*, p. 199, text-fig. 9a-c.

Type: The holotype, by monotypy, is MNHP R53926, the original of Collignon, 1965, pl. D, refigured by Amédéo, Busson & Cornée, 1996, fig. 9a-c, and Fig. 25 herein. It is from the Upper Cenomanian interval 1 with *Neolobites* of Ohanet, Illizi Province, Algeria.

Material: OUM KX1987-89, from bed 17; OUM

KX1870-72, 1874, 1875, 1983, from the base of bed 19, Foug el Guelta.

Description: All of the specimens are slightly weathered internal moulds, ranging from 68-145 mm in diameter. Coiling is very evolute, the umbilicus quite deep, broad, and comprising up to 40% of the diameter, the umbilical wall feebly convex and outward-inclined, the umbilical shoulder broadly rounded. The whorls expand slowly. The whorl breadth to height ratio varies around 1. The flanks are flattened and subparallel in intercostal section, the ventrolateral shoulders broadly rounded, the venter flattened. The costal section is polygonal with the greatest breadth at the inner ventrolateral tubercles. OUM KX1874 (Pl. XVIII, fig. 3) is 68 mm in diameter. Twenty-two ribs per whorl arise at the umbilical seam and are strong and straight across the umbilical wall and shoulder, where they strengthen into sharp umbilical bullae. These give rise to straight prorsiradiate ribs that strengthen across the flanks and link to strong, subspinose inner ventrolateral tubercles. Most of these give rise to a pair of transverse ribs that bear feebly clavate outer ventrolateral and more markedly clavate siphonal tubercles, as a result of which there are approximately twice as many ventral as umbilical ribs. OUM KX1875 (Pl. XVIII, fig. 2) is the best-preserved of the larger individuals, with a maximum preserved diameter of 134 mm. There are 12 primary ribs on the adapertural half of the outer whorl. All arise from strong umbilical bullae and are straight and prorsiradiate, broadening across the flanks, and linking to conical-bullate inner ventrolateral tubercles, the whorl section concave between umbilical and inner ventrolateral tubercles in costal section. The venter between the inner ventrolateral clavi bears subequal outer ventrolateral and siphonal clavi that are twice as numerous as the inner ventrolateral. OUM KX1989 (Pl. XVIII, fig. 1) is a further large individual, distorted into an ellipse with a maximum preserved diameter of 119 mm. The pattern of ribbing and tuberculation is as in the previous specimens, but coarser, the rib density lower with only 16 primary ribs per whorl. It closely resembles the holotype.

Discussion: This is a highly distinctive species of *Cunningtoniceras*, separated from most other species by the very evolute coiling and relatively subdued ventrolateral tuberculation. It most closely resembles *C. inerme*, described above, but differs in the persistence of outer ventrolateral and siphonal tubercles more numerous than the inner ventrolateral to maturity, whereas they are lost at an earlier ontogenetic stage in *inerme*.

Occurrence: Lower Upper Cenomanian, Illizi Province, Algeria, and Central Tunisia.

Genus and Subgenus *Calycoceras* Hyatt, 1900
(ICZN Generic Name No. 1352)

Type species: By designation under the Plenary Powers (ICZN Opinion No. 557) *Ammonites navicularis* Mantell,

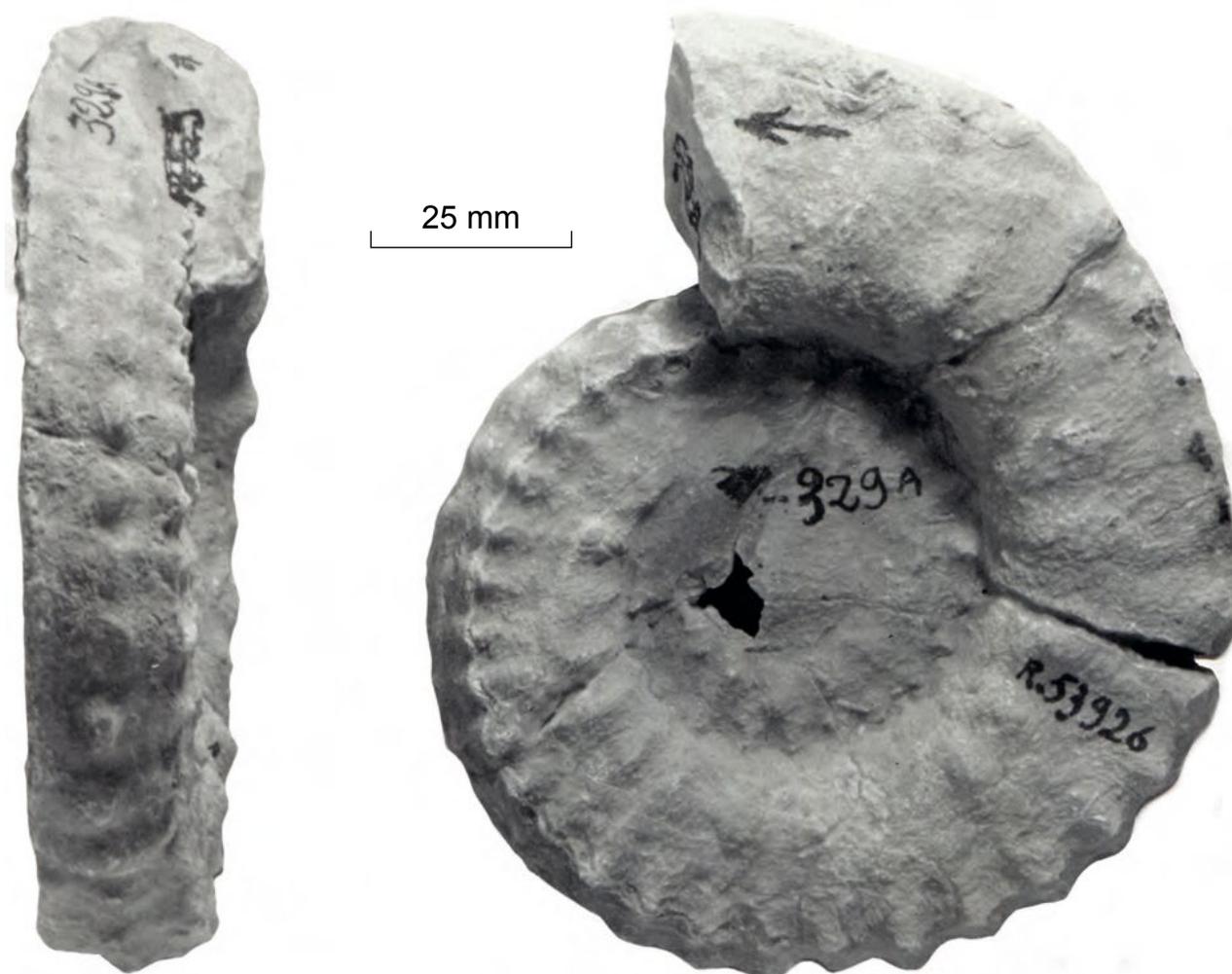


Fig. 25: *Cunningtoniceras tinrhertense* Collignon, 1965. The holotype, MNHP R53926, from the Upper Cenomanian interval 1 with *Neolobites* of Ohanet, Illizi Province, Algeria.

1822, p. 198, pl. 22, fig. 5 (ICZN Specific Name No. 1633).

***Calycoceras (Calycoceras) naviculare* (Mantell, 1822)**
Pl. XXII, fig. 6

1822. *Ammonites navicularis* Mantell, p. 198, pl. 22, fig. 5 (in error in explanation of plate: *Ammonites catinus*).

1981. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Wright & Kennedy, p. 34, pl. 4, pl. 5, figs 1-3, text-figs 13, 14c-e (with full synonymy to 1981).

1990. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Wright & Kennedy, p. 236, pl. 61, fig. 1, pl. 62, figs 1-6, pl. 63, figs 1-3, text-figs 88e, I, 89d, 110c (with additional synonymy).

1992. *Calycoceras (Calycoceras) naviculare* (Mantell).– Thomel, pl. 84, figs 2, 3.

?1992. *Thomelites* sp.– Thomel, pl. 78, figs 3, 4.

1994a. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Kennedy & Juignet, p. 19, figs 2a-c, 3a, b, 4a-c, 5a, b.

1996. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Kennedy *et al.*, p. 313, pl. 39, fig. 1.

1996. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Amédro *et al.*, p. 210, text-fig. 10.

1998. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Kaplan *et al.*, p. 152, pl. 53.

2004. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Barroso-Barcenilla, p. 89, pl. 1, fig. 2.

2013. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822).– Wilmsen & Nagm, p. 656, text-figs 9, 10.

Type: The holotype, by monotypy, is BMNH 5681, the original of Mantell (1822, pl. 22, fig. 5), from the middle Upper Cenomanian Plenus Marl of ‘Offham’, Sussex, England (see Wright & Kennedy, 1981, p. 35, pl. 4).

Material: OUM KX1870, from the base of bed 19, Foum el Guelta.

Description: The specimen is a 180° sector of phragmocone, 72 mm in diameter, with a maximum preserved whorl height of 28 mm. Coiling is involute, the

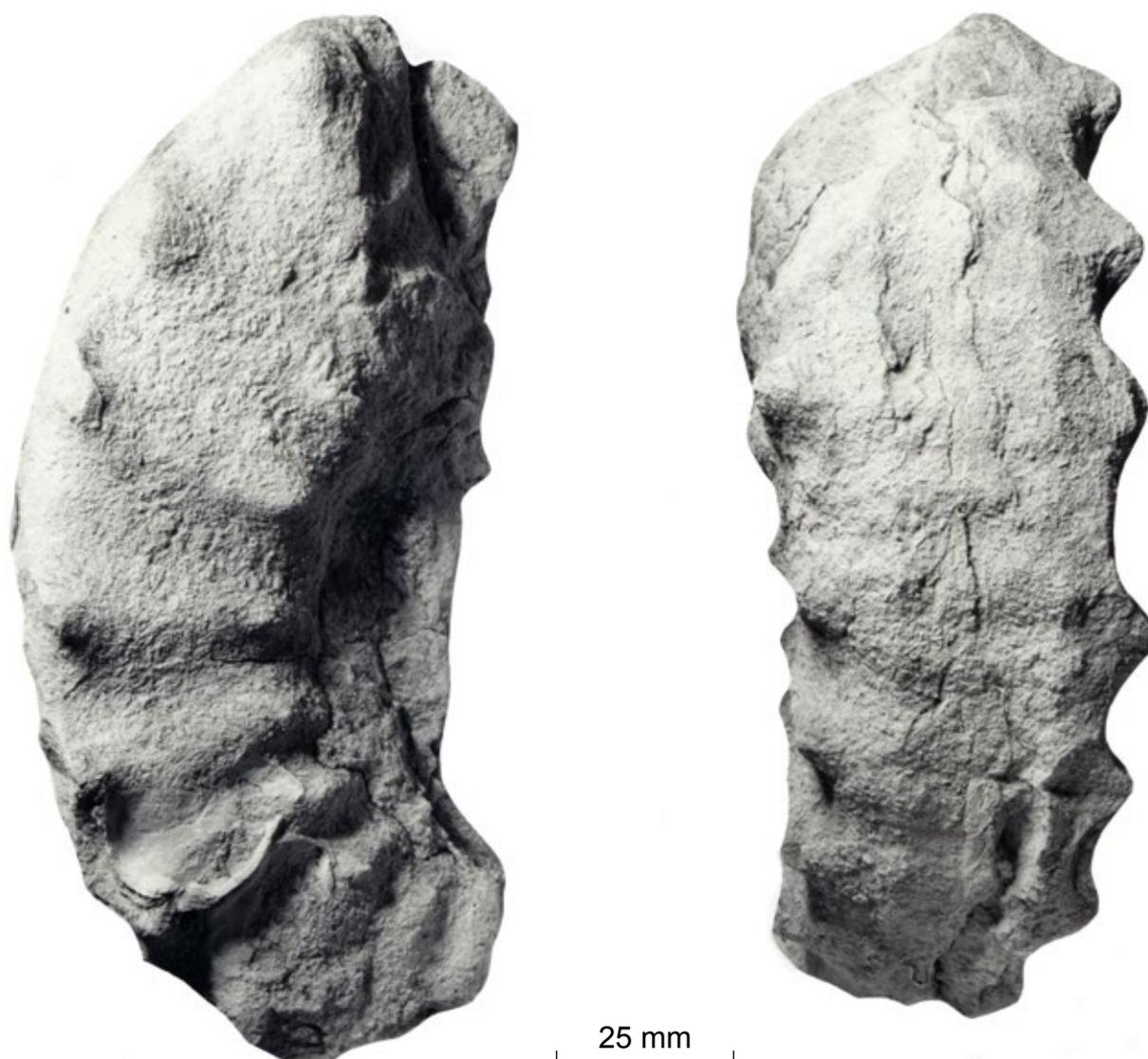


Fig. 26: *Cunninghamiceras tinrhertense* Collignon, 1965. OUM KX1863, from the base of bed 19, Fom el Guelta.

deep umbilicus comprising 28% of the diameter, the high umbilical wall flattened, the umbilical shoulder broadly rounded. The whorl section is depressed reniform, with the greatest breadth at the umbilical shoulder, the whorl breadth to height ratio 1.5 approximately. Eight strong, coarse ribs arise at the umbilical seam of the fragment, pass straight up the umbilical wall, and strengthen into prominent bullae, perched on the umbilical shoulder. They give rise to pairs of strong, coarse ribs, with occasional intercalated ribs, to give a total of 17 at the ventrolateral shoulder of the fragment. The ribs are rursiradial, sweeping backwards across the flanks, and passing straight across the venter. All ribs bear blunt outer ventrolateral bullae.

Discussion: See Wright & Kennedy (1998, p. 236).

Occurrence: Lower to middle Upper Cenomanian, *guerangeri* and *geslinianum* Zones and their correlatives. There are records from southern England, Sarthe, Loire-Atlantique, Eure-et-Loir, Touraine and Provence in France, Germany, Spain and Portugal, Romania, Algeria, Central Tunisia, the Middle East, Angola, Madagascar, south India, Japan, the United States Gulf Coast, Western Interior, and western Seaboard.

Subgenus *Calycoceras* (*Gentoniceras*) Thomel, 1972

Type species: *Ammonites gentoni* Brongniart, 1822, pp. 83, 392, pl. 6, fig. 6 from the lower Middle Cenomanian of Rouen, Seine-Maritime, France, by original designation by Thomel, 1972, p. 65.

Calycoceras (Gentoniceras) cf. gentoni
(Brongniart, 1822)

Pl. X, fig. 6; Pl. XXII, fig. 1

1822. *Ammonites gentoni* Brongniart, p. 83, 392, pl. 6, fig. 6.
 1926a. *Eucalycoceras subgentoni* Spath, p. 83.
 1990. *Calycoceras (Gentoniceras) gentoni* (Brongniart, 1822).—Wright & Kennedy, p. 219, pl. 56, figs 1-3, 6-8, pl. 57, figs 2, 3, 8, pl. 58, fig. 7, pl. 66, figs 1, 2, text-figs 88a, c, 89a, b, 90a-c (with synonymy).
 1990. *Calycoceras (Gentoniceras) subgentoni* (Spath, 1926a).—Wright & Kennedy, p. 226, pl. 56, figs 4, 5, pl. 57, fig. 4, pl. 58, figs 5, 6, pl. 59, figs 1-4, text-figs 88k, 90d-f (with synonymy).
 1994a. *Calycoceras (Gentoniceras) gentoni* (Brongniart, 1822).—Kennedy & Juignet, p. 30, figs 1a, 2d, e, 6d, e, j, k, 7a-l, 8a-e, 22a, b.
 1998. *Calycoceras (Gentoniceras) gentoni* (Brongniart, 1822).—Kaplan *et al.*, p. 156, pl. 26, figs 3-5.
 2010. *Calycoceras (Gentoniceras) gentoni* (Brongniart, 1822).—Kennedy & Klinger, p. 9, text-fig. 31.

Type: Lectotype, by the subsequent designation of R. Douvillé (1911), is the original of Brongniart (1822, pl. 6, fig. 6; Wright & Kennedy, 1990, text-fig. 190a-c), from the lower Middle Cenomanian of Rouen, Seine-Maritime, France.

Material: OUM KX3122, from bed 8, and KX3237, from bed 10 south of Sif et Tella.

Description: OUM KX3122 (Pl. X, fig. 6) has been crushed dorsoventrally into an ellipse with a maximum diameter of 37 mm, as a result of which the whorl section has been distorted, and is depressed reniform with a whorl breadth to height ratio of 1.8. There are 16 ribs per half whorl on the fragment, primary ribs arising from well developed umbilical bullae, predominantly singly, sometimes in pairs, with single long intercalated ribs. The ribs are feebly prorsiradiate, and of comparable strength on the flanks and venter, which they pass straight across. OUMKX3237 (Pl. XXII, fig. 1) is a half whorl of phragmocone with a maximum preserved length of 53 mm. It too has suffered strong dorso-ventral crushing, producing a very depressed reniform whorl section with a whorl breadth to height ratio of 1.7. There are five or six umbilical bullae on the fragment. They give rise to predominantly pairs of primary ribs, with some long intercalated ribs, to give a total of fourteen at the ventrolateral shoulder of the fragment. The ribs are prorsiradiate on the flanks, feebly convex across the venter, and of uniform strength.

Discussion: The pattern of the ribbing, lack of ventrolateral and ventrolateral tubercles, and ribs that are of essentially constant strength, indicate these to be crushed *Calycoceras (Gentoniceras)*. Given the strong deformation, the specimens compare well with material from Sarthe in France (Kennedy & Juignet 1994, text-fig. 7); accordingly they are compared to *C. (G.) gentoni*, of which *C. (G.) subgentoni* is considered no more than an intraspecific variant, as discussed by Kennedy & Juignet (1994, p. 30).

Occurrence: *C. (G.) gentoni* ranges from lower Middle to lower Upper Cenomanian. There are records from southern England, Haute-Normandie, Sarthe and Provence in France, Spain, the Münster Basin in Germany, northern KwaZulu-Natal South Africa and, possibly, northeastern Algeria, Central Tunisia, and Iran.

***Calycoceras (Gentoniceras) boehmi* (Spath, 1926b)**

Pl. XX, fig. 9

1867. *Ammonites navicularis* Guéranger (*non* Mantell), p. 6, pl. 5, fig. 5 only.
 1926b. *Metacalycoceras boehmi* Spath, p. 431.
 1994a. *Calycoceras (Gentoniceras) boehmi* (Spath, 1926b).—Kennedy & Juignet, p. 37, text-figs 5e, f, 9a-c (with additional synonymy).

Type: The neotype, designated by Kennedy & Juignet, 1994a, p. 37 is the original of their text-fig. 9, MNHP-F-A25546, from the Middle Cenomanian Sables du Mans or Sables du Perche of Le Mans, Sarthe, France.

Material: OUM KX1901, from the lower part of bed 13, Fom el Guelta.

Description: The specimen is a corroded half whorl, all but a short sector body chamber, with a maximum preserved diameter of an estimated 87 mm. Coiling is evolute, the umbilicus comprising 32% approximately of the diameter, broad and of moderate depth, the umbilical wall subvertical and feebly convex, the umbilical shoulder broadly rounded, the whorl section depressed reniform, with a whorl breadth to height ratio of 1.3 approximately, the greatest breadth below mid-flank. There are eight primary ribs on the adapical 90° sector of the outer whorl. They arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into narrow umbilical bullae. These give rise to one or two primary ribs, while additional long ribs intercalate. The ribs are narrow, straight and prorsiradiate on the flanks, strengthening across the ventrolateral shoulders and passing straight across the venter, where there are 14 ribs at the ventrolateral shoulder of the 90° whorl sector. The suture is moderately incised, with a broad bifid E/A, and narrower A.

Discussion: The present specimen has the coiling and whorl proportions of the neotype, the inner whorls of which are heavily corroded. Such as can be deciphered of the ornament is comparable. The massive whorls distinguish it from other *Gentoniceras* species.

Occurrence: Middle Cenomanian of Sarthe, France, and Djebel Mrhila, Central Tunisia.

Calycoceras (Gentoniceras) cf. lafouxense

Thomel, 1972

Pl. XXII, fig. 7

Compare:

1972. *Calycoceras (Gentoniceras) lafouxense* Thomel, p. 74, pl. 24, figs 7-11.

1990. *Calycoceras* (*Gentoniceras*) *lafouxense* Thomel.– Wright & Kennedy, text-fig. 86c-e.

Type: The holotype, by the original designation, is the original of Thomel, 1972, p. 74, pl. 24, figs 9-11, from the lower Upper Cenomanian of La Foux, Basses-Alpes, France, currently housed in the U. S. National Museum of Natural History. It was refigured by Wright & Kennedy, 1990, text-fig. 86c-e.

Material: OUM KX1992, collected loose, but derived from beds 14-17, Fom el Guelta.

Description: The specimen is a well-preserved internal mould of a half whorl of phragmocone 76 mm in diameter. Coiling is very evolute, the umbilicus comprising 35% of the diameter, shallow, with a low, flattened, outward-inclined umbilical wall, the umbilical shoulder broadly rounded. The whorl section is compressed oval in intercostal section, with feebly convex sub-parallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. The costal whorl section is rounded-polygonal, with a whorl breadth to height ratio of 1, the greatest breadth at the umbilical bullae. There are nine primary ribs per half whorl. They arise at the umbilical seam, and are strong and narrow, sweeping backwards across the umbilical wall. Some but not all develop into umbilical bullae of varying strength. The primaries are generally single on the flanks, but at the adapertural end, a pair of ribs arise from a bulla. There are one or two intercalated ribs, arising around or below mid-flank, to give a total of 20 ribs per half whorl at the ventrolateral shoulder; occasional intercalated ribs are incipiently linked to an umbilical bulla. The ribs are straight and prorsiradiate across the flanks, the primaries bearing a weak inner ventrolateral bulla, also present on most but not all of the intercalated ribs. All ribs bear a small, sharp outer ventrolateral bulla, the bullae linked across the venter by a strong, transverse rib, the ventral costal profile markedly convex, with no indication of a siphonal tubercle. The suture is poorly preserved, with a very broad, bifid E/A and narrow A.

Discussion: The specimen compares well with the holotype at the same diameter in terms of whorl proportions, rib strength and density, although more of the umbilical bullae give rise to pairs of ribs in the holotype. The species is said to possess a feeble lateral tubercle to a diameter of 40 mm; this is not seen in the present specimen, and not uniformly present in the holotype.

Occurrence: The holotype comes from Thomel's Zone 5, which also yields *Calycoceras* (*Proeucalycoceras*) *guerangeri*, of the lower Upper Cenomanian. The species is known only from southeast France and Central Tunisia.

Subgenus *Calycoceras* (*Newboldiceras*) Thomel, 1972

Type species: *Acanthoceras newboldi* Kossmat, 1897, p. 5(112), pl. 1 (12), figs 2, 3, pl. 3 (14), fig. 2, by original designation by Thomel, 1972, p. 105= *Acanthoceras*

rhotomagense var. *asiatica* Jimbo, 1894, p. 177, pl. 20, fig. 1 (fide Wright & Kennedy, 1990, p. 239).

***Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894)**

Pl. X, fig. 9; Pl. XX, fig. 6; Pl. XXIII, fig. 3

1865. *Ammonites Rotomagensis* DeFrance.– Stoliczka, p. 66 (*pars*), including *typicus* (p. 68) (*pars*) and var. *subcompressus* (p. 8), pl. 34, figs 3, 4, pl. 35, fig. 1, pl. 36, fig. 1, pl. 37, figs 1, 2.
1894. *Acanthoceras rhotomagense* var. *asiatica* Jimbo, p. 177, pl. 20, fig. 1.
1897. *Acanthoceras Newboldi* n.sp. (Typische form) Kossmat, p. 5 (112), pl. 1 (12), figs 2, 3, pl. 3 (14), fig. 2.
1903. *Acanthoceras newboldi* Kossm. – Pervinquierè, p. 66, 69, 77, 79.
1907. *Acanthoceras Jimboi* Pervinquierè, p. 262 (*non A. Jimboi* var. *tunetana*, p. 262, pl. 14, fig. 2).
1907. *Acanthoceras Newboldi* Kossmat.– Pervinquierè, p. 264, pl. 13, fig. 1.
1987. *Calycoceras* (*Newboldiceras*) *newboldi* (Kossmat). – Matsumoto, Suekane & Kawashita, p. 5, pl. 1, fig. 4, pl. 2, figs 1-3.
1990. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894).– Wright & Kennedy, p. 239, pl. 58, fig. 1, pl. 64, figs 1, 2, pl. 65, figs 1-3, 5, 7, pl. 72, fig. 3, text-figs 87a-c, 88f, 97, 98 (with full synonymy).
1991. *Calycoceras* (*Newboldiceras*) *newboldi* (Kossmat).– Matsumoto & Skwarko, p. 252, pl. 4, fig. 4.
1992. *Calycoceras* (*Newboldiceras*) *newboldi* (Kossmat).– Vařicek, p. 68, pl. 1, fig. 1, pl. 2, figs 1, 2, pl. 3, figs 2, 3, pl. 6, fig. 1 (with additional synonymy).
1993. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894).– Matsumoto & Skwarko, p. 423, figs 12, 13, 18a, e, f.
1994. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894).– Amédro in Robaszynski *et al.*, pl. 12, figs 1, 2, pl. 13, fig. 2.
2010. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894). – Kennedy & Klinger, p. 10, figs 32, 33a-f, 34j-l, p. q, 36-38, 44d, e, h, 57a-f (with additional synonymy).
2014. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894). – Kennedy & Bilotte, p. 24, text-figs 4d-f, 6j.

Type: The holotype, by monotypy is the original of Jimbo, 1894, pl. 20, fig. 1, no. 1-105 in the Collections of the Geological Institute, Tokyo University, from the Middle Cenomanian *Trigonia* Sandstone of the Ikushumbets, Hokkaido, Japan. A cast was figured by Wright & Kennedy (1990, text-fig. 97) and Kennedy & Klinger (2010, text-fig. 38).

Material: OUM KX15910, from the base of bed 13; OUM KX1996, from the base of bed 14; OUM KX1984-5, from bed 17; OUM KX1868, from the base of bed 19, Fom el Guelta. The original of Pervinquierè 1907, pl. 13, fig. 1, an unregistered specimen in the Sorbonne Collections, from Ain el Glaa, Djebel Trozza.

Description: The material from Djebel Mrhila is poor. OUM KX15910 (Pl. X, fig. 9) is a half whorl 58.5 mm in diameter. The whorl section is depressed polygonal in costal section, with a whorl breadth to height ratio of 1.32. There are 15 ribs on the fragment. Narrow prorsiradiate primaries bear small umbilical bullae, small sharp bullate inner ventrolateral tubercles and conical outer ventrolateral tubercles, linked across the venter by a strong, narrow rib, the venter feebly convex in costal section. Intercalated ribs bear inner and outer ventrolateral tubercles. OUM KX1984 (Pl. XX, fig. 6) is a nucleus with a septate fragment of the succeeding whorl with a maximum preserved whorl height of 29.7 mm. Coiling is evolute, the umbilicus deep, with a feebly convex subvertical wall and broadly rounded umbilical shoulder. The whorl section is depressed, the intercostal section with feebly convex flanks, ventrolateral shoulders broadly rounded, the venter feebly convex. The costal section is polygonal, with a whorl breadth to height ratio of 1.28, the greatest breadth at the umbilical bullae. Primary ribs arise at the umbilical seam and pass straight up the umbilical wall, strengthening and developing into five small, sharp bullae, perched on the umbilical shoulder of the 90° fragment. The bullae give rise to one or two primary ribs, with additional long ribs intercalating, to give a total of 12 ribs at the ventrolateral shoulder of the fragment. The ribs are narrow, crowded, straight and feebly prorsiradiate, with feeble inner ventrolateral bullae, small outer ventrolateral clavi, the costal section feebly convex between the clavi, with no clear indication of a siphonal tubercle. Pervinquier's figured specimen (Pl. XXIII, fig. 3) is an almost wholly septate individual, slightly deformed into an ellipse, with a maximum diameter of 94.5 mm. Coiling is evolute, the umbilicus comprising 33% of the diameter. There are approximately 20 ribs that arise at the umbilical seam, strengthen across the umbilical wall, and link to small, sharp bullae, perched on the umbilical shoulder. These give rise to predominantly single ribs, with additional long intercalated ribs, to give a total of 40-42 ribs per whorl at the ventrolateral shoulder. All ribs bear feeble inner ventrolateral bullae, rounded outer ventrolateral and feeble siphonal tubercles. As size increases, the tubercles weaken progressively, and the siphonal row is lost.

Discussion: *C. (N.) asiaticum asiaticum* is comprehensively discussed by Wright & Kennedy (1990, p. 239). It differs from *C. (N.) asiaticum spinosum* (see revision in Wright & Kennedy, 1990, p. 249, pl. 64, fig. 3, pl. 65, figs 4, 6, pl. 66, figs 3, 4, pl. 69, fig. 1, pl. 70, fig. 3, text-figs 87a-c, 88d, 1, 99, 100, 102, 107k) in the depressed whorl section and much stronger tuberculation of the latter that persists to much greater diameters. Pervinquier (1907, p. 262) introduced his *Acanthoceras jimboi* for *Acanthoceras rhotomagense* var. *asiatica* of Jimbo, and a variety *tunetana* (p. 263). As noted by Wright & Kennedy (1990, p. 249), *jimboi* is

an objective junior synonym of *asiatica*. *Acanthoceras jimboi tunetana* and *Acanthoceras confusum tunetana* Pervinquier, 1907 (p. 268) are homonymous, and the former was rejected by Wright & Kennedy as a stillborn homonym, and the latter treated as valid.

Occurrence: Upper Middle and lower Upper Cenomanian. Southern England, northern and southern France, Spain, The Czech Republic, Romania, Bulgaria, Algeria, Tunisia, KwaZulu-Natal in South Africa, Madagascar, south India, Papua-New Guinea and Japan, with possible records from Poland, Israel, and China.

Calycoceras (Newboldiceras) asiaticum spinosum
(Kossmat, 1897)

Pl. XXI, figs 2, 4; Pl. XXIII, fig. 1

1897. *Acanthoceras Newboldi* var. *spinosa* Kossmat, p. 7 (114), pl. 2 (13), figs 2, 3; pl. 3 (14), fig. 1.
1903. *Acanthoceras newboldi* Kossmat.– Pervinquier, p. 66.
1907. *Acanthoceras newboldi* Kossmat var. *spinosa*.– Pervinquier, p. 265, pl. 13, figs 2, 3.
1990. *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897).– Wright & Kennedy, p. 249, pl. 64, fig. 3, pl. 65, figs 4, 6, pl. 66, figs 3, 4, pl. 69, fig. 1, pl. 70, fig. 3, text-figs 87a-c, 88d, 1, 99, 100, 102, 107k (with full synonymy).
1994. *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897).– Kennedy, p. 228, pl. 9, figs 1-3, 7-9, pl. 10, figs 12, 13.
1997a. *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat).– Wilmsen, pl. 12, fig. 1, pl. 20, fig. 1.
2010. *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat).– Kennedy & Klinger, p. 12, text-figs 33g-r, 34m, o, 35a-j, m-o, r, s, 39-43.

Types: Lectotype, designated by Wright & Kennedy (1990, p. 250) is the original of Kossmat's 1897, pl. 2 (13), fig. 2, from the Utatur Group of Odium, South India. Paralectotypes are the originals of Kossmat's pl. 2 (13), fig. 3, and pl. 3 (14), fig. 1. The paralectotype of Stoliczka, 1865, pl. 35, fig. 2 may belong elsewhere.

Material: The originals of Pervinquier 1907, pl. 13, figs 2, 3, unregistered specimens in the Sorbonne Collections, from Kef et Tella (=Kef Si Abd el Kader), Djebel Mrhila. OUM KX1902-3, 1905-6, and 1908, from the lower part of bed 13, OUM KX1949 and 2042, collected loose, Foum el Guelta. OUM KX3226, from bed 10 south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
Pervinquier pl. 23, fig. 2	51.5 (100)	29.0 (56.3)	23.2 (45.0)	1.25	14.6 (28.3)

Description: Fragments range from 32 mm diameter. The original of Pervinquier 1907, pl. 23, fig. 2 (Pl. XXIII, fig. 1) is a juvenile with a maximum preserved diameter of 51.5 mm. Coiling is fairly evolute, the umbilicus comprising 28.3% of the diameter, deep, with a flattened

wall and narrowly rounded umbilical shoulder. The intercostal section is depressed reniform, the costal whorl section depressed polygonal, with a whorl breadth to height ratio of 1.25, the greatest breadth at the umbilical bullae. Fifteen to sixteen ribs arise at umbilical seam and strengthen across the umbilical wall and shoulder, where they develop into sharp, subspinose umbilical bullae of variable strength. The bullae give rise to one or two straight, rectiradiate primary ribs, while single ribs intercalate. All ribs strengthen across the flanks, and bear sharp, bullate inner ventrolateral tubercles. A straight, transverse rib extends across the ventrolateral shoulders and venter and bears weaker outer ventrolateral and siphonal clavi. The total rib density cannot be established because of the damaged nature of the specimen. Pervinquière's larger fragment (1907, pl. 13, fig. 2), OUM KX1908 (Pl. XXI, fig. 2) and KX1902 (Pl. XXI, fig. 4) are closely comparable. The last is a 90° sector of phragmocone with a maximum preserved costal whorl height of 36.6 mm. The whorl section is very depressed reniform in intercostal section, with a whorl breadth to height ratio of 1.4. The costal whorl breadth to height ratio is 1.44, the greatest breadth at the umbilical bullae. The umbilicus is deep, with a convex, outward-inclined umbilical wall and broadly rounded umbilical shoulder. Six primary ribs arise at the umbilical seam, sweep back, strengthen, and are feebly concave across the umbilical wall as shoulder, where they bear sharp bullae. There is a single long intercalated rib. The ribs are strong, straight and feebly rursiradiate, strengthening progressively across the flanks and passing straight across the venter. All bear strong inner ventrolateral bullae and conical outer ventrolateral tubercles, the venter arched and feebly convex in costal section between. There is no indication of a siphonal tubercle. OUM KX1908 (Pl. XXI, fig. 2) has comparable ornament, the ventrolateral tubercles subspinose.

The suture is moderately incised, with a very deep E, E/A broad and bifid, A narrow and bifid.

Discussion: The present specimens agree closely with Kossmat's figures, the original of Pl. XXIII, fig. 1 with Kossmat's pl. 2 (13) fig. 3, and the originals of Pl. XXI, figs 2, 4, with the lectotype [Stoliczka 1897, pl. 2 (13), fig. 2)]. Differences from *C. (N.) asiaticum asiaticum* are outlined above.

Occurrence: Upper Middle and lower Upper Cenomanian, southern England, France, Spain, Romania, Bulgaria, Central Tunisia, KwaZulu-Natal in South Africa, Madagascar, South India, Tibet (?), Japan and California.

Calycoceras (Newboldiceras) planecostatum
(Kossmat, 1897)

Pl. XX, fig. 7

1897. *Acanthoceras Newboldi* var. *planecostata* Kossmat, p. 9 (116), pl. 2 (13), fig. 1.

1990. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Wright & Kennedy, p. 252, pl. 61, figs 2, 3; pl. 67, figs 1-4; text-figs 101c-e (with full synonymy).
1994. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy, p. 228, pl. 10, figs 2, 3.
1994b. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy & Juignet, p. 50, text-figs 1c, 18a-c, 19a-c.
1996. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy *et al.*, p. 314, pl. 40, fig. 3.
1998. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kaplan *et al.*, p. 158, pl. 26, figs 9-11.
2004. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy & Jolkičev, p. 376, pl. 3, figs 2-6, 8, 9.
2010. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy & Klinger, p. 14, text-figs 34d, g, h, 35k, l, p, q, 44f, g, 46-54, 56a-k, 57h, 61a, b.
2014. *Calycoceras (Newboldiceras) planecostatum* (Kossmat, 1897).– Kennedy & Bilotte, p. 26, text-figs 4a-c.

Type: The lectotype, by the subsequent designation of Wright & Kennedy (1990, p. 252), is no. 14842 in the Collections of the Geological Survey of India, the original of Kossmat [1897, pl. 2(13), fig. 1], from the Utatur Group of Odium, south India. A cast was figured by Wright & Kennedy (1990, text-fig. 101d, e) and Kennedy & Klinger (2010, text-fig. 54)

Material: OUM KX1995, 1997-8, from bed 14, and KX1992, from beds 14-17, Fom el Guelta.

Description and Discussion: The material from Djebel Mrhila is slight. OUM KX1995 (Pl. XX, fig. 7) is a 120° whorl sector of phragmocone with a maximum preserved whorl height of 23 mm. The umbilicus is of moderate depth, the umbilical wall feebly convex, the umbilical shoulder rounded, the whorl section depressed, with a costal whorl breadth to height ratio of 1.2, the intercostal whorl section slightly depressed reniform. The inner to middle flanks are feebly convex and subparallel, the outer flanks converging to the broadly rounded ventrolateral shoulders and feebly convex venter. There are six primary ribs on the fragment. They arise at the umbilical seam, and strengthen across the umbilical wall and shoulder, developing into small bullae. These give rise to single ribs that are straight and rectiradiate on the inner flank, then flexing back slightly, strengthening, and linking to small ventrolateral clavi, linked across the venter by a straight to very feebly convex rib. The primaries alternate with one or two long or short intercalated ribs (the former in some cases tenuously linked to a bulla) to give a total of 16 ribs at the ventrolateral shoulder of the fragment. OUM K1998 is a smaller fragment with a maximum preserved whorl height of 19 mm, similar whorl proportions and ornament.

The distinguishing features of *C. (N.) planecostatum* are the crowded ribbing combined with very early loss of inner ventrolateral and siphonal tubercles, features well-shown by the present fragments.

Occurrence: Upper Middle and lower Upper Ceno-

manian, southern England, France, Germany, northern Spain, Iran, Morocco, Central Tunisia, KwaZulu-Natal in South Africa, Madagascar, South India and James Ross Island (Antarctica).

Calycoceras (Newboldiceras) cf. vergonsense
(Collignon, 1937)

Pl. X, figs 4, 7

Compare:

1937. *Calycoceras (Eucalycoceras) vergonsense* Collignon, p. 42 (18), pl. 5, fig. 1.
 1972. *Newboldiceras (Subeucalycoceras) vergonsense* (Collignon).—Thomel, p. 115, pl. 35, figs 1, 2, pl. 47, figs 1, 2.
 1990. *Calycoceras (Newboldiceras) vergonsense* (Collignon, 1937).—Wright & Kennedy, p. 263, pl. 61, fig. 5, pl. 74, fig. 4, text-figs 109, 110a, 111.
 1992. *Calycoceras (Newboldiceras) vergonsense* (Collignon).—Thomel, pl. 6, figs 1, 2, pl. 8, figs 1, 2, pl. 16, figs 1, 2.
 1996. *Calycoceras (Newboldiceras) vergonsense* (Collignon, 1937).—Wright & Kennedy, p. 401, pl. 122, fig. 2, pl. 123, fig. 2.
 1998. *Calycoceras (Newboldiceras) vergonsense* (Collignon, 1937).—Kaplan *et al.*, p. 162, pl. 49, fig. 2.

Type: The holotype, by monotypy, is the original of Collignon, 1937, pl. 5, fig. 1, from the Cenomanian of Vergons, Basses-Alpes, France. Collignon stated that the specimen was in his own collection, but we have failed to trace it.

Material: OUM KX1904 and 15912, from the lower part of bed 13 south of Foug el Guelta.

Description: OUM KX1904 (Pl. X, fig. 7) is a 120° sector of phragmocone with a maximum preserved whorl height of 18.8 mm. Coiling is very evolute, the umbilicus of moderate depth. The umbilical wall is flattened and subvertical, the umbilical shoulder quite narrowly rounded. The intercostal whorl section is depressed, with feebly convex flanks, broadly rounded ventrolateral shoulders and a broad, flattened venter. The costal whorl section is depressed polygonal, with a whorl breadth to height ratio of 1.32, the greatest breadth at the umbilical bullae. There are nine ribs on the fragment, primary ribs and long intercalated ribs alternating regularly. The primary ribs arise at the umbilical seam, pass straight up the umbilical wall, strengthening progressively and developing into narrow bullae on the umbilical shoulder. The bullae give rise to a straight rib, initially weakening before strengthening and linking to a sharp inner ventrolateral bulla, the rib as a result concave in costal profile between the tubercles. A narrow, sharp rib passes straight across the ventrolateral shoulders and venter, and links to a sharp outer ventrolateral bulla, the rib profile again concave between the tubercles. The ventral costal whorl section is concave immediately adjacent to the outer ventrolateral tubercles and very feebly convex across most of the venter. OUM KX15911 (Pl. X, fig. 4) is a larger, 60°, partially septate fragment

with a maximum preserved whorl height of 25 mm. The costal whorl section is depressed, with a whorl breadth to height ratio of 1.64, the whorl section and coiling as in the previous specimen. There are parts of eight ribs on the fragment. All are primaries, well-developed across the umbilical wall, strengthened into very narrow bullae on the umbilical shoulder, straight to very feebly concave and rectiradiate across the flanks, and linking to sharp inner ventrolateral bullae, from which the ribs pass straight across the ventrolateral shoulders and venter, bearing weak outer ventrolateral bullae. The ventral ribs are narrow, much narrower than the interspaces, and concave between the outer ventrolateral bullae.

E is deep, E/A broad and bifid, occupying much of the outer part of the venter, A is relatively narrow and bifid, U2 relatively small.

Discussion: The present specimens are much smaller than previously described material referred to *C. (N.) vergonsense*. The pattern of flank ribbing corresponds to that of the inner whorls of the specimen figured by Thomel (1972, pl. 47, figs 1, 2), as does the whorl section, although all previous specimens, apparently adult body chambers, lack ventrolateral tubercles, but have the same distinctive costal whorl section.

Occurrence: Lower Middle Cenomanian of southern England, southeastern France, and Central Tunisia.

Calycoceras (Newboldiceras) tunisiense nom. nov.

Pl. XXI, fig. 5, Fig. 27

1907. *Acanthoceras jimboi* var. *tunetana* Pervinquière, p. 263, pl. 14, fig. 2.

Name of the species: Wright & Kennedy (1990, p. 249) rejected *Acanthoceras jimboi* var. *tunetana* Pervinquière, 1907, p. 263, pl. 14, fig. 2, as a stillborn homonym of *Acanthoceras confusum* var. *tunetana* Pervinquière, 1907, p. 268, pl. 13, fig. 4. Accordingly, *tunisiense* is proposed herein as *nomen novum* for the former.

Type: The holotype, by monotypy is the original of *Acanthoceras jimboi* var. *tunetana* of Pervinquière, 1907, pl. 14, fig. 2, illustrated here as Pl. XXI, fig. 2, an unregistered specimen in the Sorbonne Collections, from Kef Si Abd El Kader.

Description: The holotype is a 90° sector of phragmocone with a maximum preserved whorl height of 63.5 mm, a costal whorl breadth to height ratio of 0.87 and an intercostal whorl breadth to height ratio of 0.8. The umbilicus is of moderate depth, with a broadly rounded wall and shoulder, the intercostal whorl section compressed oval, the costal section compressed polygonal. Six broad, blunt primary ribs arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where they bear strong, sharp umbilical bullae. Each gives rise to a pair of ribs. The adapical rib of each pair is strong, straight and rectiradiate, the adapertural one much weaker, and only tenuously linked to a bulla. The

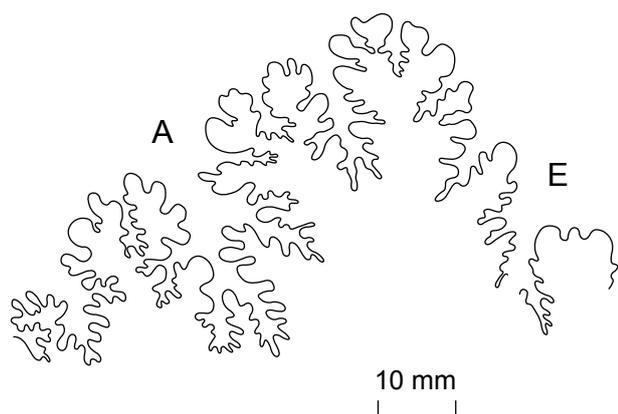


Fig. 27: *Calycoceras (Newboldiceras) tunisiense* sp. nov. External suture line of the holotype, an unregistered specimen in the Sorbonne Collections, the original of Pervinquière, 1907, pl. 14, fig. 2 (Pl. XXI, fig. 5 herein).

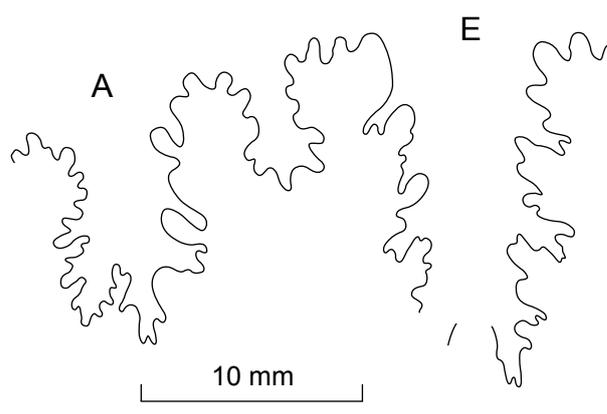


Fig. 28: *Calycoceras (Newboldiceras)* sp. External suture of OUM KX3225 (Pl. XXII, fig. 5, herein).

differentiation into strong adapical and weak adapertural ribs persists to the ventrolateral shoulder, where all of the strong, and some of the weaker ribs bear sharp inner ventrolateral bullae. A low, broad, blunt rib connects to a weak, feebly clavate outer ventrolateral tubercle, and a broad, coarse rib passes straight across the venter, with a faint suggestion of a siphonal tubercle on some of the ribs.

The suture (Fig. 27) has a broad, bifid, deeply incised E/A and a narrow, deeply incised A.

Discussion: The holotype appears to be from the adapertural end of an adult phragmocone. When compared to *Calycoceras (Newboldiceras) asiaticum asiaticum*, the less massive, compressed whorl section, arched venter, and tendency of the ribs to arise in pairs from umbilical bullae are distinctive. *C. (N.) asiaticum spinosum* differs by its spinose ventrolateral tubercles. *C. (N.) asiaticum hunteri* (Kossmat, 1897) [p. 116 (90), pl. 3 (14) fig. 4; see revision in Wright & Kennedy, 1990, p. 251, text-figs 90g, h, 103, 104, 110b] has primary ribs only at the same size as the holotype of *tunisiense*.

Occurrence: Central Tunisia and northeastern Algeria.

Calycoceras (Newboldiceras) sp.?

Pl. XXII, fig. 4, Fig. 28

Material: OUM KX3225, from bed 10, south of Sif et Tella.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
OUM KX3225 at c	47.8	24.6	19.7	1.24	14.4
	(100)	(51.5)	(41.2)		(30.1)

Description: The specimen is just over half a whorl of an internal mould of a phragmocone. Coiling is very evolute, the umbilicus comprising just over 30% of the

diameter, deep, with a feebly convex outward-inclined wall and broadly rounded umbilical shoulder. The intercostal whorl section is depressed oval, with convex flanks, broadly rounded ventrolateral shoulders, and a broad, feebly convex venter. The costal whorl section is very depressed, polygonal, with a whorl breadth to height ratio of 1.24, the greatest breadth at the umbilical bullae. Nine strong, narrow primary ribs arise at the umbilical seam, passing slightly forwards, strengthening progressively, and developing into an umbilical bulla of variable strength, the adapicalmost bulla subspinose. The bullae give rise to a single rib or a pair of recti- to feebly rursiradiate ribs that are straight on the flanks. Single ribs intercalate around mid-flank to give a total of 19 ribs at the ventrolateral shoulder. All ribs bear small, sharp inner ventrolateral bullae, from which a broader transverse rib links to a widely separated weaker conical to feebly transversely elongated outer ventrolateral tubercle. The ribs weaken markedly, and link to a stronger siphonal clavus, which appears, as a result, to be flanked by a groove on either side. The suture (Fig. 28) is moderately incised, with a broad, bifid E/A and narrow A.

Discussion: Ribs arising in pairs from bullae, and the distinctive ventral ornament, the siphonal tubercles flanked by shallow depressions separate the specimen from others of comparable size in the present collection. Of described taxa, the flank ornament, with ribs arising in pairs from umbilical bullae, most closely resembles that of the original of *Acanthoceras newboldi* var. *ankomakaensis* Collignon, 1937 (p. 40, pl. 3, fig. 7, pl. 8, fig. 6), from Ankomaka in southwest Madagascar, reillustrated here as Fig. 29. The venter of this specimen lacks, however, the distinctive ventral morphology of the Tunisian specimen, which we leave in open nomenclature.

Occurrence: As for material.

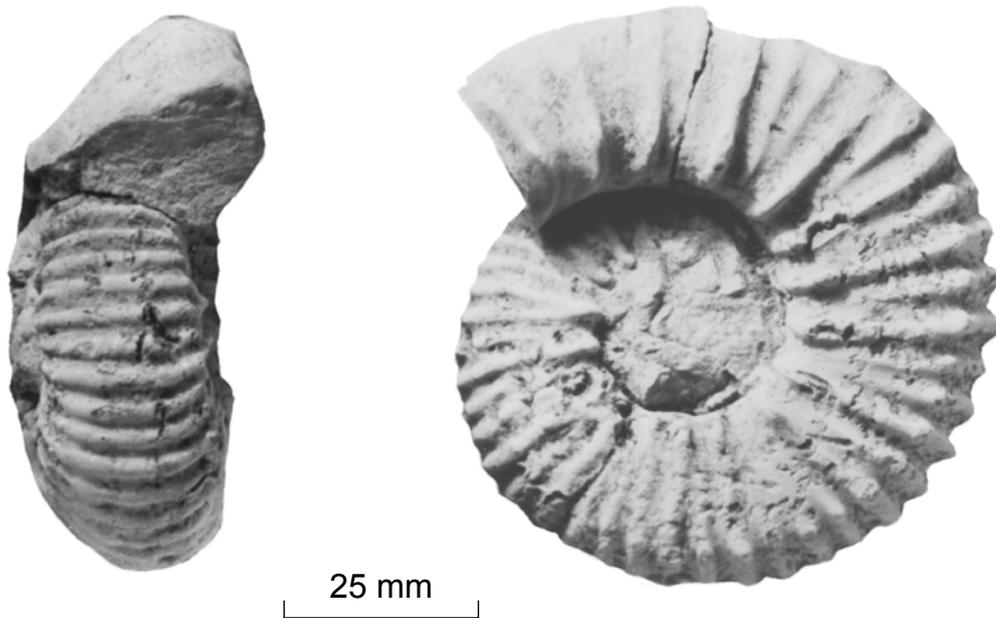


Fig. 29: *Acanthoceras newboldi* var. *ankomakaensis*, the original of Collignon, 1937, p. 40, pl. 3, fig. 7, pl. 8, fig. 6, from Ankomaka in southwest Madagascar. The specimen is currently housed in the collections of the Université de Bourgogne, Dijon.

Genus *Pseudocalycoceras* Thomel, 1966

Type species: *Ammonites harpax* Stoliczka, 1864, p. 72 (*pars*), pl. 3, fig. 1 only, by the original designation of Thomel, 1966, p. 650.

***Pseudocalycoceras haugi* (Pervinquier, 1907)**

Pl. XIX, fig. 5, Pl. XX, fig. 5, Fig. 22B

1907. *Acanthoceras haugi* Pervinquier, p. 270, pl. 14, fig. 1, text-figs 104, 105.
 1925. *Acanthoceras haugi* Pervinquier.– Diener, p. 161.
 ?1940. *Ac. haugi* Perv.– Basse, p. 450.
 ?1962. *Calycoceras haugi* (Pervinquier).– Avnimelech & Shores, p. 532.
 non 1972. *Pseudocalycoceras* (*Haugiceras*) *haugi* (Pervinquier).– Thomel, p. 97, pl. 31, figs 7, 8.
 non 1972. *Pseudocalycoceras* (*Haugiceras*) cf. *haugi* (Pervinquier).– Thomel, p. 97.
 1978. *Pseudocalycoceras haugi* (Pervinquier).– Cooper, p. 99, text-fig. 22 (copy of Pervinquier, 1907, pl. 14, fig. 1).
 non 1990. *Calycoceras* (*Proeucalyoceras*) cf. *haugi* (Pervinquier, 1907).– Wright & Kennedy, p. 276, pl. 70, fig. 2; pl. 74, fig. 1.
 1994b. *Calycoceras* (*Proeucalyoceras*) *haugi* (Pervinquier, 1907).– Kennedy & Juignet, p. 484, text-fig. 6d, e.

Types: Lectotype, by the subsequent designation of Wright & Kennedy, 1990, p. 276, is the original of Pervinquier 1907, p. 271, pl. 14, fig. 1, text-fig. 104, from Kef Si Abd El Kader. We have failed to recognise this specimen in the Sorbonne Collections, and reproduce the

original illustration here as Pl. XIX, fig. 5. The second, paralectotype fragment mentioned by Pervinquier is illustrated here as Pl. XX, fig. 2; the original label reads: “Foum el Guelta... *Acanth haugi* Perv.”

Material: OUM KX1895, from the base of bed 13, Foum el Guelta.

Description; The paralectotype fragment (Pl. XX, fig. 2) is a 180° whorl sector 55.8 mm long, with a maximum preserved whorl height of 26.8 mm. Coiling is evolute, the umbilicus of moderate depth, with a flattened subvertical wall and broadly rounded umbilical shoulder. The whorl section is rounded-trapezoidal in intercostal section and polygonal in costal section, with a whorl breadth to height ratio of 1.0, the greatest breadth at the umbilical bullae. Parts of six ribs are preserved on the fragment. They arise at the umbilical seam and are low and broad on the umbilical wall, strengthening markedly across the umbilical shoulder and developing into strong umbilical bullae. These give rise to single coarse straight prorsiradial ribs that strengthen progressively across the flanks and venter, and bear strong inner ventrolateral bullae and outer ventrolateral and siphonal clavi. The adapical four ribs are separated by single intercalated ribs that arise both low and high on the flanks. The long intercalated ribs bear a full complement of ventrolateral and siphonal tubercles; the short ribs lack the inner ventrolateral. The fragment retains part of the external suture, with a broad E/A and narrow A (Fig. 22B).

OUM KX1895 (Pl. XX, fig. 5) is a half whorl with a maximum preserved diameter of 87.6 mm, retaining a 120° sector of body chamber. Coiling is very evolute, the umbilicus comprising 33% of the diameter. The

umbilicus is of moderate depth on the phragmocone part of the specimen, where the intercostal whorl section is compressed rounded-trapezoidal, the costal whorl section polygonal, the whorl breadth to height ratio 0.93, the greatest breadth at the umbilical bullae. Primary ribs arise at the umbilical seam, and strengthen across the umbilical wall, developing into relatively weak bullae, displaced slightly outwards of the umbilical shoulder. They give rise to single straight rursiradiate primary ribs, separated by single intercalated ribs that arise low on the flanks, and strengthen to match the primaries. All ribs bear weak, feebly clavate inner ventrolateral tubercles, linked across the venter by a strong, straight transverse rib that bear strong subequal outer ventrolateral and siphonal clavi. On the body chamber, the umbilical wall decreases in elevation and is inclined outwards rather than subvertical, and the umbilical bullae weaken and efface. The ventrolateral and siphonal clavi also weaken, all features suggesting the specimen to be an adult. The suture is quite deeply incised, with a broad bifid E/A, and deep, narrow A.

The missing lectotype (Pervinquierè 1907, pl. 14, fig. 1: see Pl. XIX, fig. 5 herein) was figured without the adapertural half whorl of body chamber. The nucleus, as illustrated, is 95 mm in diameter. The whorl breadth to height ratio is 1.14, the umbilicus comprising 38% of the diameter according to Pervinquierè. There are 14 strong umbilical bullae perched on the umbilical shoulder, and 25 ribs at the ventrolateral shoulder. On the adapertural part of the penultimate whorl, ribs arise in pairs from the bullae. On the adapical part of the outer whorl, a second rib is only tenuously attached to a bulla, thereafter, primary and intercalated ribs alternate. All ribs bear rounded-conical inner ventrolateral tubercles and slightly weaker outer ventrolateral and siphonal clavi.

Discussion: Thomel (1972, p. 97) regarded *Acanthoceras rhotomagense* var. *judaica* of Taubenhau, 1920 (p. 13, pl. 3, fig. 1) as synonymy of *haugi*; it is interpreted as a separate species here, and described below. The *Pseudocalycoceras* (*Pseudocalycoceras*) *haugi* of Thomel (1972, p. 97, pl. 31, figs 7, 8) has straight, feebly prorsiradiate ribs and comes from a lower Middle Cenomanian horizon; it belongs to some other species.

Pseudocalycoceras batnense (Collignon, 1937), described below, is compressed, high-whorled, the whorls expanding more rapidly, with a smaller umbilicus, the ribs commonly arising in pairs from the umbilical bullae.

Occurrence: Lower Upper Cenomanian, Djebel Mrhila. Lower Upper Cenomanian of Sarthe, France. Other records are doubtful.

***Pseudocalycoceras judaicum* (Taubenhau, 1920)**

Pl. XXI, fig. 3, Fig. 30A-F

1920. *Acanthoceras rhotomagense* Bron. var. *judaica* Taubenhau, p. 13, pl. 3, fig. 1.

1925. *A. rotomagende* (sic) var. *judaica* Taubenhau.– Diener, p. 165.

1962. *Protacanthoceras judaicum* (Taubenhau).– Avnimelech & Shores, p. 531, pl. 15, fig. 1, text-fig. 1.

1962. *Protacanthoceras* aff. *compressum* (Jukes-Browne).– Avnimelech & Shores, p. 532, pl. 15, fig. 2, text-fig. 2.

2013. *Calycoceras* (*Proeucalycoceras*) *guerangeri* (Spath, 1926).– Ahmad, Barragán, Szives & Vegas-Vera, p. 25, text-figs 3a-c, 4a-b.

2013. *Calycoceras* (*Proeucalycoceras*) *picteti* Wrigh & Kennedy, 1990.– Ahmad, Barragán, Szives & Vegas-Vera, p. 26, text-figs 4c, 5a-b.

2013. *Calycoceras* (*Proeucalycoceras*) aff. *picteti* Wrigh & Kennedy, 1990.– Ahmad, Barragán, Szives & Vegas-Vera, p. 27, text-fig. 5c.

2013. *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894).– Ahmad, Barragán, Szives & Vegas-Vera, p. 27, text-figs 6a-b.

2013. *Pseudocalycoceras harpax* (Stoliczka, 1864).– Ahmad, Barragán, Szives & Vegas-Vera, p. 28, text-figs 7a, b.

Type: The holotype is the original of Taubenhau, 1920, p. 13, pl. 3, fig. 2, no. 2171-P in the collections of the Hebrew University, Jerusalem. It was refigured by Avnimelech & Shores (1962, pl. 15, fig. 1; text-fig. 1), and is from the Calcaires à *Acanthoceras* (Kefar Sha'ul Formation) west of Jerusalem. A cast is illustrated here (Fig. 30A, B).

Material: OUM KX1890, from the lower part of bed 13, Fom el Guelta.

Description: The specimen is a 60° whorl sector from the adapertural end of the phragmocone with three camerae and a short sector of body chamber preserved. The maximum preserved whorl height is 39 mm. The umbilical wall is of moderate elevation, convex and outward-inclined, the umbilical shoulder broadly rounded. The intercostal whorl section is rounded-trapezoidal, and feebly compressed. The costal whorl is compressed polygonal, the breadth to height ratio 0.82, the greatest breadth at the umbilical bullae. Three strong coarse ribs are present on the umbilical wall of the fragment. They link to umbilical bullae, two of them strong and subspinose, the third much weaker. The bullae give rise to strong straight prorsiradiate primary ribs, separated by single long strong intercalated ribs, some tenuously linked to an umbilical bulla. All ribs bear strong conical inner ventrolateral tubercles, linked by a broad, wedge-shaped rib to a strong outer ventrolateral clavus, the clavi linked across the venter by a low, broad transverse rib bearing an elongate siphonal clavus. The imperfectly preserved sutures are quite deeply incised, with a large bifid lobes and saddles.

Discussion: The Tunisian specimen is referred to *judaicum* of Taubenhau on the basis of comparisons with a cast of the holotype and a suite of topotypes (OUM KY1317-20). A cast of the holotype (OUM KY917: Fig. 30A, B) shows the original to be crushed and highly distorted, comprising a 180° whorl sector 90 mm in diameter, with a maximum preserved whorl height of 45.3 mm. The umbilicus comprises 23.3% of

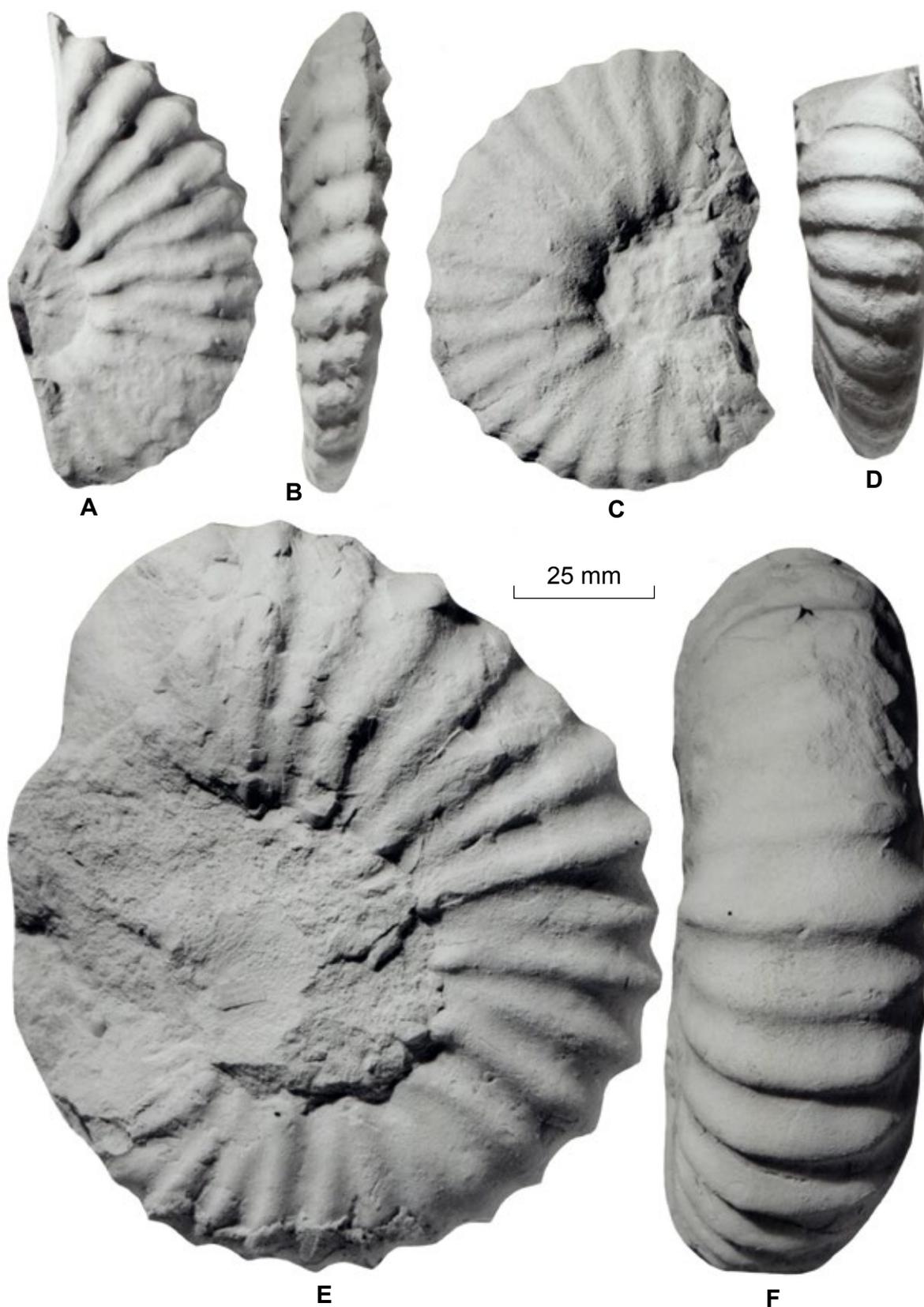


Fig. 30: *Pseudocalycoceras judaicum* (Taubenhaus, 1920). A, B: cast of the holotype, the original of Taubenhaus, 1920, p. 13, pl. 3, fig. 2, no. 2171-P in the collections of the Hebrew University, Jerusalem, from the Calcaires à *Acanthoceras* (Kefar Sha'ul Formation) west of Jerusalem. C, D: OUM KY1314, a microconch; E, F: OUM KX1316, a macroconch. Both specimens are from the same unit as the holotype in the environs of the Holocaust Memorial, west Jerusalem.

the diameter. Seven strong bullae perch on the umbilical shoulder, and there are 15 ribs at the ventrolateral shoulder. The bullae give rise to pairs of ribs on the adapical part of the fragment, beyond which primary ribs alternate, with long secondary ribs that are in some cases tenuously linked to a bulla. The primary ribs are straight and prorsiradiate, strengthening across the flanks and bearing conical inner ventrolateral tubercles, strong outer ventrolateral and slightly weaker siphonal clavi. The intercalated ribs bear a similar complement of tubercles. Individuals comparable to the holotype of *judaicum* in terms of ornament but uncrushed, show the species to be compressed and high-whorled. There are also finer ribbed individuals, and one incomplete adult microconch (OUM KY1317: Fig. 30C, D) just over 80 mm in diameter that shows loss of ventrolateral and siphonal tuberculation at the greatest preserved diameter, the ribs flat-topped, broad, with narrower interspaces, indicating it to be an adult. The macroconch is represented by OUM KY1316: Fig. 30E, F). These specimens overlap in morphology with ammonites from the Shuayb Formation of northwestern Jordan that Ahmad *et al.* (2013) referred to *Calycoceras* (*Proeucalycoceras*) *guerangeri* (Spath, 1926), *Calycoceras* (*Proeucalycoceras*) *picteti* Wright & Kennedy, 1990, *Calycoceras* (*P.*) aff. *picteti*, *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), and *Pseudocalycoceras harpax* (Stoliczka, 1864), which are regarded here as a single variable species, referable to *judaicum* (it should be noted that the figures of these ammonites, described by Ahmad *et al.* as being natural size, are in fact greatly reduced).

Occurrence: Middle Cenomanian of Israel, Jordan, and Central Tunisia.

***Pseudocalycoceras jullieni* (Collignon, 1937)**

Pl. XIX, figs 1-4, 6, Pl. XX, figs 3, 4, Pl. 21, fig. 3,
Pl. XXII, figs 2, 3, Fig. 31A, B, F-H, Fig. 32

1937. *Protacanthoceras jullieni* Collignon, p. 36 (12), pl. 2, figs 1, 2; pl. 8, fig. 3.

Types: Collignon (1937, p. 36, pl. 2, figs 1, 2; pl. 8, fig. 3; see Text-fig. 31A, B, F-H herein) based his *Protacanthoceras jullieni* on two specimens in the Ecole des Mines Collections from the Cenomanian of Batna in northeastern Algeria. They are currently housed in the collections of the Université de Bourgogne, Dijon; the original of Collignon's pl. 2, fig. 1 (Fig. 31F-H) is designated lectotype. The paralectotype is the original of Collignon, 1937, pl. 2, fig. 2 (Fig. 31A, B).

Material: OUM KX1889-95, 1897-99, 15909, from the base of bed 13; OUM KX1986, from bed 17; OUM KX1991, from beds 14-17 of the Foug el Guelta section.

Dimensions:

	D	Wb	Wh	Wb:Wh	U
OUM KX1892c	55.7 (100)	26.7 (47.9)	29.3 (52.6)	0.91	11.6 (20.8)
OUM KX1893c	56.6 (100)	25.1 (44.3)	29.4 (51.9)	0.85	11.3 (20.0)
OUM KX1899c	66.4 (100)	30.3 (45.6)	30.6 (46.1)	1.0	16.0 (24.1)
OUM KX1897c	81.3 (100)	29.6 (36.4)	39.8 (49.0)	0.68	20.1 (24.8)

Description: The lectotype (Fig. 31F-H) is crushed, 85 mm in diameter, and septate to 65 mm diameter. Coiling is moderately evolute, with 33% of the previous whorl covered. The umbilicus comprises 28% of the diameter and is of moderate depth, the umbilical wall flattened, the umbilical shoulder rounded. The whorl section is compressed, the degree of compression enhanced by the crushing. The costal whorl section is polygonal, with the greatest breadth at the umbilical bullae. Eleven low, broad, distant primary ribs arise on the umbilical seam, strengthen across the umbilical wall and develop into coarse distant bullae, perched on the umbilical shoulder. The bullae give rise to one or two strong, distant, feebly prorsiradiate ribs, pairs of ribs dominating on the adapical half of the outer whorl, the second rib only tenuously attached to a bulla or intercalating. All ribs strengthen markedly on the outer flank, and bear strong rounded-conical inner ventrolateral tubercles. A strengthened rib links to outer ventrolateral and siphonal clavi that are weaker than the inner ventrolateral tubercles. The paralectotype (Collignon, 1937, pl. 2, fig. 2; Fig. 31A-B) is a crushed, largely septate fragment with a maximum preserved whorl height of 36 mm, the ornament as in the lectotype. These specimens differ in no significant respects from the present material, the crushed lectotype corresponding to OUM KX1897 (Pl. XIX, fig. 6).

Turning to the much better preserved material from Djebel Mrhila, coiling is evolute, the umbilicus of moderate depth, the umbilical wall feebly convex, the umbilical shoulder broadly rounded. The intercostal whorl section is compressed, with flattened, subparallel flanks, the ventrolateral shoulders broadly rounded, the venter feebly convex. The costal whorl breadth to height ratio ranges from 0.68-1.0, the greatest breadth at the umbilical bullae. The whorl section is polygonal, and concave between the tubercles. The smallest specimen seen is OUM KX1991 (Pl. XX, fig. 4), a 180° whorl sector 29 mm in diameter. Five prominent bullae perch on the umbilical shoulder, and give rise to pairs of straight, coarse, recti- to feebly prorsiradiate ribs, while occasional ribs intercalate, to give a total of 11 ribs at the ventrolateral shoulder. All ribs bear conical to feebly clavate inner ventrolateral tubercles, linked by a strong, feebly prorsiradiate rib to strong ventral clavi, linked over the venter by a strong transverse rib bearing an equal siphonal tubercle. OUM KX1891 (Pl. XX,

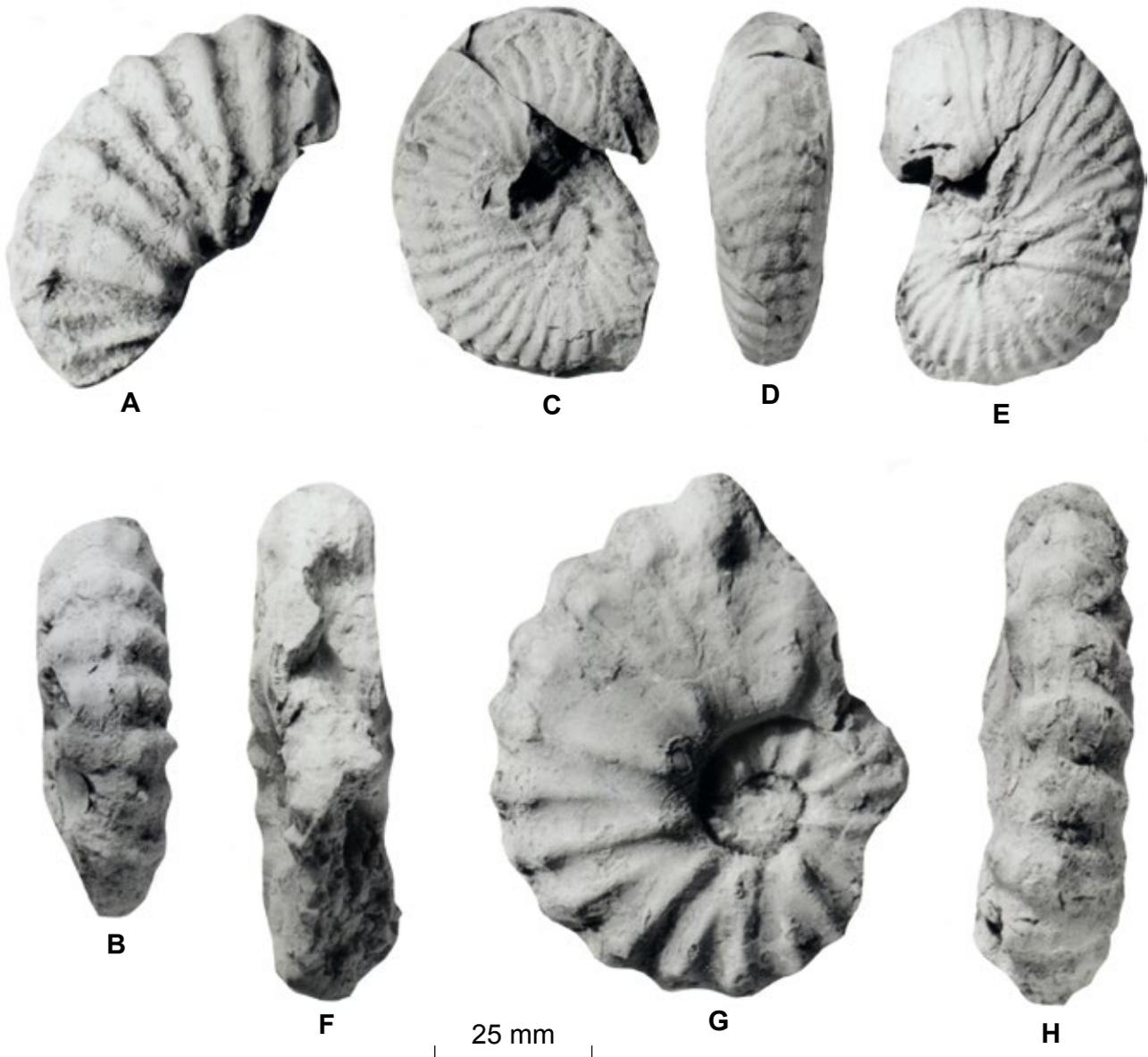


Fig. 31: A, B, F-H, *Pseudocalycoceras jullieni* (Collignon, 1937). A, B: paralectotype, the original of Collignon, 1937, pl. 2, fig. 2; F-H: lectotype, the original of Collignon, 1937, pl. 2, fig. 1. C-E, *Eucalycoceras batnense* (Collignon, 1937). The original of var. *temuis* of Collignon, 1937, pl. 2, fig. 4. All specimens are from the environs of Batna, Tunisia, and currently housed in the Collections of the Université de Bourgogne, Dijon.

fig. 3), 49 mm in diameter, is a finer-ribbed variant with a comparable style of ribbing and tuberculation, with seven umbilical bullae and 15 ribs per half whorl at the ventrolateral shoulder. OUM KX1893 (Pl. XIX, fig. 1) is a well-preserved, coarsely ornamented compressed individual 55.6 mm in diameter, retaining a 240° sector of body chamber. The costal whorl breadth to height ratio is 0.85. Nine progressively coarsening umbilical bullae perch on the umbilical shoulder. Relatively weak on the adapical half of the outer whorl, they strengthen markedly on the adapertural half and give rise to pairs of ribs, one of the pair weakly attached; there are occasional

long intercalated ribs. All link to strong rounded-clavate inner ventrolateral tubercles, from which a broad rib sweeps forwards to a low broad transverse rib that links equal outer ventrolateral and siphonal clavi. OUM KX1899 (Pl. XIX, fig. 3) is a robust individual 68 mm in diameter with a costal whorl breadth to height ratio of 1.0. There are an estimated 12 umbilical bullae per whorl, weak on the adapical half of the outer whorl, but strengthening markedly on the adapertural half. They give rise to pairs of ribs, with tuberculation as in the previous specimen, to give a total of 23-24 ribs at the ventrolateral shoulder. OUM KX1897 (Pl. XIX, fig. 6),

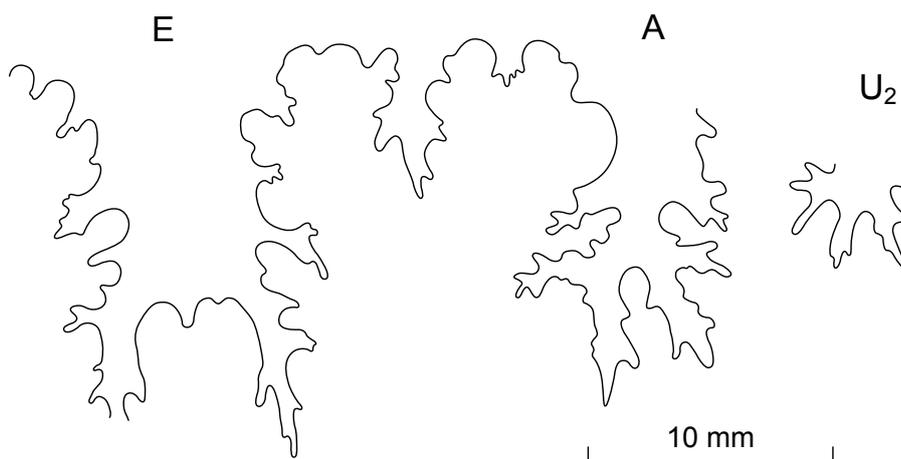


Fig. 32: Partial external suture of *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1899.

81 mm in diameter, retains just under half a whorl of body chamber with seven umbilical bullae and 14 ribs at the ventrolateral shoulder per half whorl. OUM KX1986 (Pl. XIX, fig. 4) is comparable, but septate to a diameter of over 70 mm. In contrast, OUM KX1894 (Pl. XIX, fig. 2), a body chamber, shows a change to single ribs that lack bullae, and are of variable strength on the umbilical shoulder, suggesting the specimen to be part of an adult body chamber.

Discussion: Differences from *Pseudocalycoceras haugi* are discussed above. *Pseudocalycoceras harpax* (Stoliczka, 1864, p. 72, pl. 39, fig. 1, non pl. 38, fig. 2) is much more densely and finely ribbed, the ribs flexuous rather than straight, and becoming markedly rursiradiate on the body chamber.

Occurrence: Upper Middle and lower Upper Cenomanian, northeastern Algeria and Central Tunisia.

Genus *Eucalycoceras* Spath, 1923
(ICZN Generic Name no. 1354)

Type species: *Ammonites pentagonus* Jukes-Browne, 1896, p. 156, pl. 5, fig. 1, by the original designation of Spath, 1923, p. 144 (ICZN Specific name no. 1635).

***Eucalycoceras pentagonum* (Jukes-Browne, 1896)**
Pl. XXI, fig. 1

1896. *Ammonites pentagonus* Jukes-Browne, p. 156, pl. 5, fig. 1.
1907. *Acanthoceras pentagonum* Jukes-Browne & Hill.– Pervinquier, p. 271.
1990. *Eucalycoceras pentagonum* (Jukes-Browne, 1896).– Wright & Kennedy, p. 282, pl. 78, figs 1, 3, pl. 79, figs 1-5, text-figs 89e, 123a, b (with full synonymy).
1992. *Eucalycoceras pentagonum* (Jukes-Browne).– Thomel, pl. 78, figs 1, 5, pl. 79, figs 1-4, pl. 80, figs 1 (?), 3.
1992. *Eucalycoceras* gr. *pentagonum* (Jukes-Browne).– Thomel, pl. 78, fig. 2, pl. 79, fig. 5.
1994. *Eucalycoceras pentagonum* (Jukes-Browne, 1896).– Amédéo in Robaszynski *et al.*, p. 413, pl. 15, figs 4, 5, 9.

1996. *Eucalycoceras pentagonum* (Jukes-Browne, 1896).– Kennedy *et al.*, p. 316, pl. 39, figs 6, 7; pl. 40, figs 1, 2, 4 (with additional synonymy).
2014. *Eucalycoceras pentagonum* (Jukes-Browne, 1896).– Kennedy & Bilotte, p. 28, figs 4g-i, 6i.

Type: The holotype, by monotypy, is BGS GSM 5348, the original of Jukes-Browne, 1896, p. 156, pl. 5, fig. 1, from the remanié phosphatic fauna of bed C of the Cenomanian Limestone at Humble Point, west of Lyme Regis, Devon. It was refigured by Wright & Kennedy (1990, pl. 79, fig. 5).

Material: An unregistered specimen in the Sorbonne Collections, ex Flick collection, the original of Pervinquier, 1907, p. 271, from Foum el Guelta. OUM KX1876-79, from bed 19, Foum el Guelta.

Description: The best preserved fragment is the Flick specimen (Pl. XXI, fig. 1), a crushed 120° sector of phragmocone with a maximum preserved whorl height of 29.5 mm and a whorl breadth to height ratio of 0.91. The umbilical wall is flattened and outward-inclined, the umbilical shoulder narrowly rounded, with a high oval intercostal and a polygonal costal whorl section. Nine ribs arise on the umbilical wall of the fragment, and strengthen into sharp bullae, perched on the umbilical shoulder. The bullae give rise to one, occasionally two narrow, sharp, crowded ribs, while additional long or short ribs intercalate to give a total of 18 at the ventrolateral shoulder of the fragment. The ribs are straight and prorsiradiate across the flanks, and pass straight across the venter. All bear sharp inner and outer ventrolateral and siphonal tubercles.

Discussion: See Wright & Kennedy (1984, p. 282).

Occurrence: The species first appears in the lower Upper Cenomanian *Calycoceras guerangeri* Zone, and extends into the succeeding *Metoicoceras geslinianum* Zone, with records from southern England, Sarthe, Provence and Peche de Foix, Ariège, France, Spain, Portugal, Tadjikistan, Algeria, Central Tunisia, Madagascar, south

India, Japan, and Colorado and New Mexico in the United States.

***Eucalycoceras batnense* (Collignon, 1937)**

Pl. XXI, fig. 6, Pl. XXII, fig. 9; Fig. 31C-E

1937. *Protacanthoceras batnense* Collignon, p. 36, pl. 2, figs 3, 4 (var. *tenuis*), pl. 8, fig. 4.

1972. *Pseudocalyoceras (Pseudocalyoceras) batnense* (Collignon), 1937.– Thomel, p. 88.

Type: The holotype, by monotypy is the original of Collignon 1937, pl. 2, fig. 3, from the Cenomanian of Batna in northeastern Algeria. We have not traced this specimen. The original of var. *tenuis* Collignon 1937, pl. 2, fig. 4, reillustrated here as Fig. 31C-E, is currently housed in the collections of the Université de Bourgogne, Dijon.

Material: OUM KX1896, from the base of bed 13, Foug el Guelta. OUM KX1443, from the middle of bed 13 south of Sif et Tella.

Description: OUM KX1443 (Pl. XXI, fig. 6) is a 60° sector of phragmocone, with a maximum preserved whorl height of 32 mm. Coiling is involute, the umbilicus small, of moderate depth, with a low, flattened wall and broadly rounded umbilical shoulder. The whorl section is compressed with a whorl breadth to height ratio of 0.88, the greatest breadth below mid-flank, the flanks feebly convex, the outer flanks converging to broadly rounded ventrolateral shoulders and a very feebly convex, near-flat venter in intercostal section. Four primary ribs arise at the umbilical seam and strengthen across the umbilical wall and shoulder, where three develop weak bullae of various strengths, but the fourth lacks a bulla. Single long ribs intercalate between successive primaries, one tenuously linked to an umbilical bulla. The ribs are straight and prorsiradiate to mid-flank, where they are feebly convex, and feebly concave on the outer flank, to give a distinctive falcoid course to the ribs. All ribs bear a tiny, progressively effacing inner ventrolateral bulla, and a stronger outer ventrolateral clavus, the clavi linked across the venter by a low, broad, transverse rib with a weaker siphonal clavus. OUM KX1896 (Pl. XXII, fig. 9) is a 180° whorl sector, 84 mm in diameter, with a 60° sector of body chamber preserved. Approximately 45% of the previous whorl is covered, the umbilicus comprising 24% of the diameter, with a feebly convex subvertical wall and broadly rounded umbilical shoulder. The costal whorl breadth to height ratio is 0.92, the greatest breadth at the umbilical bullae. Ornament is irregular, with inner flank ornament absent on the adapical end of the fragment. The basic pattern is of well-developed narrow bullae of variable strength giving rise to single ribs, with single long intercalated ribs between, the ribs feebly falcoid on the adapical part of the fragment, but straight and broadening markedly across the flanks on the adapertural part. There are 14 ribs at the ventrolateral shoulder of the fragment, with well-developed inner

ventrolateral bullae on the adapical part, but effaced on the adapertural part, together with well-developed outer ventrolateral and siphonal clavi borne on a broad feebly convex rib.

The suture is moderately incised, with a broad bifid E/A, narrower A, and asymmetrically bifid A/U2.

Discussion: These two fragments are interpreted as finer (OUM KX1443) and coarser ribbed (OUM KX1896) variants of *Eucalycoceras batnense*, the larger fragment overlapping in size with, and differing in no significant respects from the holotype. *Eucalycoceras pentagonum*, has more numerous, straight ribs throughout the phragmocone, with rounded-conical rather than markedly clavate outer ventrolateral and siphonal tubercles, and highly distinctive broad, flat-topped ribs separated by much narrower interspaces on the adult body chamber (Wright & Kennedy, 1990, p. 78, fig. 3; pl. 79, figs 4, 5).

Occurrence: Upper Middle Cenomanian, northeastern Algeria and Central Tunisia.

Genus *Thomelites* Wright & Kennedy, 1973

Type species: *Jeanrogericeras sornayi* Thomel, 1966, p. 431, pl. 11, figs 1-3, by the original designation of Wright & Kennedy, 1973, p. 231(25).

***Thomelites sornayi* (Thomel, 1966)**

Pl. XVIII, fig. 4

1966. *Protacanthoceras sornayi* Thomel, p. 432, pl. 11, figs 1-3.
1990. *Thomelites sornayi* (Thomel, 1966).– Wright & Kennedy, p. 286, pl. 80, fig. 1, pl. 81, figs 1-6, pl. 82, figs 1-8, pl. 83, figs 1-3, pl. 84, figs 1-7, text-figs 107a-d, 125c, g, h, 126a-c, f, 127a-d (with full synonymy).
1992. *Thomelites sornayi sornayi* (Thomel, 1966).– Thomel, p. 129, pl. 69, figs 1-4, pl. 70, figs 1-8, p. 71, figs 1-5.
1992. *Thomelites sornayi planum* (Thomel, 1972).– Thomel, p. 133, pl. 64, fig. 1, pl. 75, figs 1-5, pl. 76, figs 1-3, 8, 9, pl. 77, figs 1-8.
1992. *Thomelites sornayi flandrini* (Thomel).– Thomel, p. 135, pl. 65, figs 1, 6, 7, pl. 66, figs 1-9, pl. 67, figs 1-5, pl. 68, figs 1-5.
1992. *Thomelites sornayi lattense* (Thomel).– Thomel, p. 139, pl. 64, fig. 4, pl. 72, figs 1-4, pl. 73, figs 1-5, pl. 74, figs 1-6.
- non 1992. *Thomelites sornayi* (Thomel) (? nov. ssp.).– Thomel, p. 142, pl. 78, figs 3, 4 [= *Calycoceras naviculare* (Mantell, 1822)].
1992. *Calycoceras (Newboldiceras) hippocastanum* (Sowerby) passant à *Thomelites* Thomel, pl. 63, fig. 4.
1992. *Thomelites* gr. *sornayi* (Thomel, 1992).– Thomel, pl. 76, fig. 7.
1992. *Pseudocalyoceras lattense* (Thomel, 1966).– Vašiček, p. 70, pl. 3, fig. 1, pl. 4, figs 1, 2.
1992. *Thomelites flandrini* (Thomel, 1966).– Vašiček, p. 71, pl. 5, fig. 3, pl. 6, fig. 4.
1994. *Thomelites sornayi* (Thomel, 1966). – Amédéo in Robaszynski *et al.*, p. 413, pl. 15, fig. 6.
- 1997a. *Thomelites sornayi* (Thomel, 1966).– Wilmsen, pl. 20, fig. 2, non pl. 38, fig. 4.

1997b. *Thomelites sornayi* (Thomel, 1966).– Wilmsen, p. 325, pl. 1, fig. 1.

2014. *Thomelites sornayi* (Thomel, 1966).– Kennedy & Bilotte, p. 28, text-figs 5a, b, e, 6a-c, f-h.

Type: The holotype, by monotypy, is no. 178 in the Thomel collection in the Faculté des Sciences, Nice, the original of Thomel, 1966, p. 432, pl. 11, figs 1-3, from the Upper Cenomanian of Les Lattes, Alpes-Maritimes, France.

Material: OUM KX1994, from the base of bed 14, Foug el Guelta.

Dimensions:

	D	Wb	Wh	Wb;Wh	U
OUM KX1994 c	54.9 (100)	24.9 (45.30)	22.0 (40.1)	1.1	17.8 (31.0)

Description: The specimen is an internal mould of a phragmocone with a maximum preserved diameter of 56 mm. Coiling is very evolute, the umbilical wall notched to accommodate the inner ventrolateral tubercles of the preceding whorl. The umbilicus comprises 31% of the diameter, and is of moderate depth, with a feebly convex, outward-inclined wall, and broadly rounded umbilical shoulder. The intercostal whorl section is as wide as high, and rounded-trapezoidal. The costal whorl section is polygonal, with a whorl breadth to height ratio of 1.1, the greatest breadth at the umbilical bullae and inner ventrolateral tubercles. Fourteen ribs arise at the umbilical seam, and strengthen across the umbilical wall, where they are broad and coarse, strengthening into sharp umbilical bullae. On the adapical half of the outer whorl, they give rise to single coarse straight, rectiradiate primary ribs that link to conical subspinose inner ventrolateral tubercles, from which a strong transverse rib links to weaker conical outer ventrolateral tubercles, linked across the venter by a weaker rib bearing a much weaker siphonal clavus. The primary ribs are separated by short intercalated ribs that arise around mid-flank, and lack inner ventrolateral tubercles, but have outer ventrolateral and siphonal tubercles as on the primary ribs. On the adapertural half of the outer whorl, ornament changes. A pair of ribs arise from a single bulla, the adapical of the pair lacking an inner ventrolateral tubercle. Beyond this pair, there are single primary ribs with umbilical and inner ventrolateral tubercles as on the adapical primary ribs, but here the inner ventrolateral tubercles give rise to a low, broad, V-shape rib, the outer edges strengthened so that a pair of ridges develop and link to very long outer ventrolateral clavi, linked across the venter by a low, broad rib, with a weaker siphonal clavus as long as the outer ventrolateral. At this point the interspaces are much narrower than the ribs on ventrolateral shoulders and venter. The suture is moderately incised, with broad bifid lobes and saddles.

Discussion: Thomel (1992) provided extensive descriptions and illustrations of *Thomelites sornayi*; the

present specimen falls within the range of variation illustrated, comparing well with his pl. 66, figs 1-4. *Thomelites hancocki* Juignet & Kennedy, 1976 (p. 123, pl. 34, fig. 2; see revision in Wright & Kennedy, 1990, p. 285, pl. 80, figs 3-10, text-figs 107g, 125e, f) is a much smaller species, more closely ribbed, the outer ventrolateral tubercles less markedly clavate, the ribs more markedly prorsiradiate in the outer part, with some ribs that branch from the inner ventrolateral tubercles.

Occurrence: Upper Cenomanian *Calycoceras guerangeri* Zone and correlatives, southern England, Sarthe, Anjou, Touraine, Basse-Alpes, and Alpes-Maritimes in France, Cantabria Province, in northern Spain, central Tunisia, and Sergipe, Brazil.

Subfamily Euomphaloceratinae Cooper, 1978

Genus *Lotzeites* Wiedmann, 1969

Type species: *Acanthoceras aberrans* Kossmat, 1895, p. 202 (106), pl. 24 (10), fig. 4, by the original designation of Wiedmann, 1960, p. 731.

***Lotzeites elegans* sp. nov.**

Pl. XVI, figs 2, 3

1907. *Acanthoceras meridionale* Stoliczka variété *Africana* Pervinquier, p. 279 (*pars*), pl. 15, fig. 2 only.

Type: The holotype, here designated, is an unregistered specimen in the Sorbonne Collections (*ex* Flick Collection), the original of Pervinquier, 1907, p. 279 (*pars*), pl. 15, fig. 2 only, from Foug el Guelta, illustrated here as Pl. XVI, fig. 3.

Diagnosis: A *Lotzeites* with well-developed outer ventrolateral and siphonal tubercles on the early whorls.

Material: OUM KX1910, from bed 13, Foug el Guelta.

Dimensions:

	D	Wb	Wh	Wb;Wh	U
Holotype c	38.3 (100)	25.3 (66.1)	16.0 (41.7)	1.58	10.3 (26.9)

Description: The holotype is a well-preserved, partially limonitised phragmocone with a maximum preserved diameter of 40.1 mm. Coiling is moderately evolute, the deep umbilicus comprising 26.9% of the diameter, the umbilical wall flattened, the umbilical shoulder broadly rounded. The intercostal whorl section is depressed reniform. The costal whorl breadth to height ratio is 1.58, the greatest breadth at the umbilical bullae, the flanks concave between umbilical and ventrolateral tubercles, the venter very broad and convex. Eight primary ribs arise at the umbilical seam of the adapertural half of the outer whorl and pass straight up the umbilical wall, strengthening progressively and developing into very strong, sharp umbilical bullae. These give rise to single strong, straight rectiradiate ribs that link to strong, sharp,

subspinose inner ventrolateral tubercles. At the adapical end of the outer whorl fragment these give rise to a strong rib that passes straight across the venter, bearing strong equal outer ventrolateral and siphonal tubercles. Single intercalated ribs bear inner and outer ventrolateral and siphonal tubercles. The outer ventrolateral decline and efface, and the siphonal clavi weaken, so that the primary ribs on the adapertural 90° sector bear strong umbilical and inner ventrolateral tubercles and a feeble siphonal bulla. The pattern of ribbing is complex, with the inner ventrolateral tubercles on one flank giving rise to a pair of ribs. These may link to the corresponding tubercle on the opposite flank, or one links to the corresponding tubercle on the other flank, the other terminating as a nontuberculate intercalatory, while primary ribs on one flank with umbilical, inner and outer ventrolateral and siphonal tubercles terminate on the ventrolateral shoulder of the opposite flank without developing an inner ventrolateral tubercle. Occasional interspaces are deepened into weak constrictions. The suture is moderately incised, with a broad, bifid E/A, broad A, and small bifid U2.

OUM KX1910 (Pl. XVI, fig. 2) is a 180° sector of phragmocone 40.8 mm in diameter, with a costal whorl breadth to height ratio of 1.4. There are six ribs on the adapical 90° sector; three primary ribs alternate with single long intercalated ribs. The primaries arise at the umbilical seam, and are strongly developed across the umbilical wall, strengthening into well-developed sharp umbilical bullae. These give rise to strong straight prorsiradiate ribs that link to strong conical inner ventrolateral tubercles. A broad, straight, transverse rib links to a conical outer ventrolateral tubercle, linked across the venter by a transverse rib that bears a transversely elongated mid-ventral tubercle. The intercalated ribs are restricted to the venter, and bear a transversely elongated mid-ventral tubercle. On the adapertural 90° sector of the specimen there are four primary ribs, with sharp umbilical bullae and stronger subspinose inner ventrolateral tubercles. The outer ventrolateral tubercles are weakened, and there is a weak transversely elongated mid-ventral tubercle. The intercalated ribs are restricted to the venter, and bear a comparable, weak mid ventral tubercle, as do the primaries. Two interspaces are strengthened into poorly defined constrictions.

Discussion: The presence of outer ventrolateral and siphonal tubercles distinguish *Lotzeitites elegans* sp. nov. from *L. aberrans* of comparable size (see Wright & Kennedy, 1990, pl. 85, figs 3-6).

Occurrence: As for material.

Genus *Pseudaspidoceras* Hyatt, 1903

Type species: *Ammonites footeanus* Stoliczka, 1864, p. 101, pl. 52, figs 1, 2, by the original designation of Hyatt, 1903, p. 106.

***Pseudaspidoceras* cf. *pseudonodosoides*
(Choffat, 1898)**

Text-fig. 33

Compare:

1898. *Acanthoceras* (?) *pseudonodosoides* Choffat, p. 65, pl. 16, figs 5-8, pl. 22, figs 32, 33.
 1989. *Pseudaspidoceras pseudonodosoides* (Choffat, 1898).– Cobban *et al.*, p. 40, figs 41, 81-83 (with synonymy).
 2004. *Pseudaspidoceras pseudonodosoides* (Choffat, 1898).– Amédro in Robaszynski *et al.*, p. 413, pl. 14, figs 4, 6, 8.
 2005. *Pseudaspidoceras pseudonodosoides* (Choffat, 1898).– Gale *et al.*, p. 179, text-figs 6g, 8b-e.
 2005. *Pseudaspidoceras* gr. *pseudonodosoides* (Choffat, 1898).– Meister & Abdallah, p. 126, pl. 5, fig. 3 (with synonymy).
 2009. *Pseudaspidoceras pseudonodosoides* (Choffat, 1898).– Lehmann & Herbig, p. 69, pl. 2, figs c, d ; text-fig. 7c.
 2012. *Pseudaspidoceras* gr. *pseudonodosoides* (Choffat, 1898).– Meister & Abdallah, p. 435, pl. 8, figs 1-8, pl. 9, figs 1-6.

Type: The lectotype, by the subsequent designation of Cobban *et al.*, 1989, p. 40, is the original of Choffat, 1898, p. 65, pl. 16, fig. 5, from Costa d'Arnes, Portugal.

Material: OUM KX334, 341, and 737 from the Bahloul Formation correlative, south of Sif et Tella. OUM KX8216, from the same unit in Central Djebel Mrhila.

Description and Discussion: The material is poorly preserved and corroded as a result of pressure solution. OUM KX8216 (Fig. 33) is a worn internal mould of half a whorl 127 mm in diameter. Coiling is very evolute, the umbilicus comprising 37% of the diameter, relatively shallow, with feebly convex umbilical wall and broadly rounded umbilical shoulder. The whorl section is as wide as high, rounded-trapezoidal in intercostal section and polygonal in costal section, the greatest breadth at the umbilical bullae. There are nine primary ribs on the fragment. Blunt bullae perch on the umbilical shoulder, and give rise to single straight, coarse, quite widely separated feebly prorsiradiate ribs that link to a coarse conical inner ventrolateral tubercle, from which a coarse transverse rib links to a weaker rounded-bullate outer ventrolateral tubercle.

OUM KX340 is a body chamber 122 mm in diameter of a coarsely ribbed variant, with an estimated eight to nine ribs coarse at the ventrolateral shoulder, with inner ventrolateral tubercles.

Although worn, the coiling and ornament of these specimens is that of *Pseudaspidoceras pseudonodosoides*. OUM KX8216 compares with the specimen from Djebel Semmama figured by Meister & Abdallah (2012, pl. 9, fig. 2). OUM KX340 compares well with the larger individual from New Mexico figured by Cobban *et al.* (1989, fig. 83i, j).

Occurrence: Upper Upper Cenomanian *Neocardioceras juddii* Zone, of which it is an alternative index. The geographic distribution extends from Portugal to

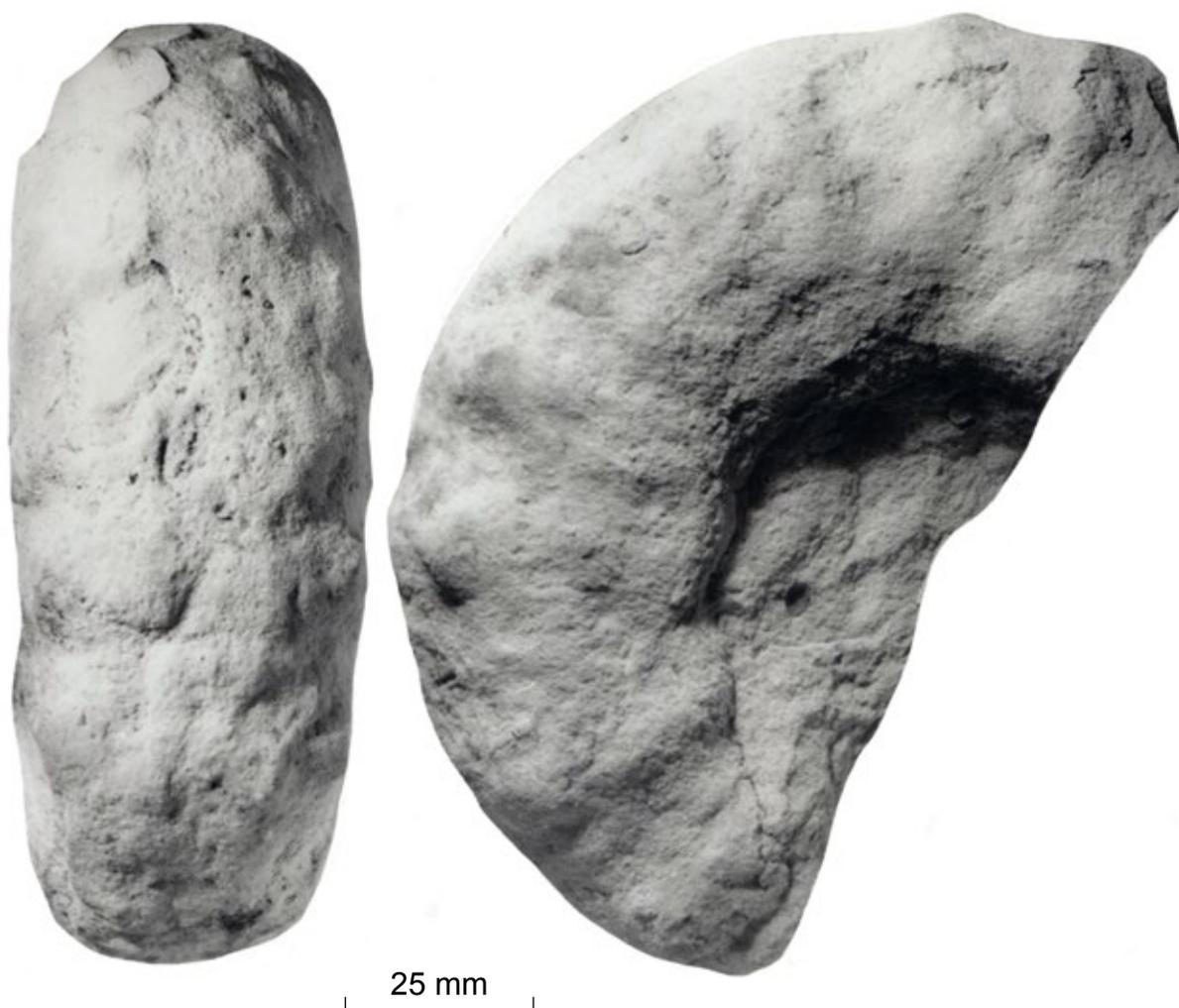


Fig. 33: *Pseudaspidoceras pseudonodosoides* (Choffât, 1898). OUM KX8216, from the correlative of the Bahloul Formation, central Djebel Mrhila.

Morocco, Algeria, Tunisia, Israel, Nigeria, Brazil, and New Mexico, Arizona, and Trans-Pecos Texas in the United States.

Suborder Ancyloceratina Wiedmann, 1966
 Superfamily Turrilitoidea Gill, 1871
 Family Anisoceratidae Hyatt, 1900
 Genus *Algerites* Pervinquier, 1910

Type species: *Algerites sayni* Pervinquier, 1910, p. 47, pl. 10 (1), figs 21-25, from the Lower Cenomanian of Algeria, by the original designation of Pervinquier, 1910, p. 46.

Algerites cf. ellipticus (Mantell, 1822)
 Pl. XXIV, fig. 14

Compare:

1822. *Hamites ellipticus* Mantell, p. 122, pl. 23, fig. 9.
 1995. *Algerites ellipticus* (Mantell, 1822).– Wright & Ken-

nedy, p. 312, pl. 92, figs 4, 11, pl. 93, figs 2, 3, 9, pl. 94, figs 2, 5-7, 10-12, text-fig. 128a (with full synonymy).

1998. *Algerites cf. ellipticus* (Mantell, 1822). – Kaplan *et al.*, p. 184.

Type: The holotype by monotypy is BMNH 8611, from the Lower Cenomanian Chalk Marl of Middleham, near Ringmer, Sussex, the original of Mantell, 1822, pl. 23, fig. 9, refigured by Wright & Kennedy, 1995, pl. 94, fig. 11.

Material: OUM KX1200, from the lower part of bed 3 south of Foug el Guelta.

Description: The specimen is a crushed limonitic fragment 6.3 mm long, with a maximum preserved whorl height of 13.7 mm. Five ribs are present. They are strongly prorsiradiate, weak on the inner flank but strengthening progressively on the outer flank, where they link to small, sharp ventral clavi. The venter is concave between the clavi.

Discussion: Slight though this fragment is, dense

prorsiradiate ribs, all with sharp ventral clavi are characteristic of Mantell's species. *Algerites sayni* Pervinquier, 1910 [p. 47, pl. 110 (1), figs 21-25; see revision in Wright & Kennedy 1995, p. 312, pl. 94, fig. 1, text-figs 128d, 130a-i] is distinguished on the basis of the finer branching and intercalated ribs and the presence of constrictions.

Occurrence: Lower Lower Cenomanian, *carcitanense* Subzone of the *mantelli* Zone where well-dated. The species is known from southern England, France, possibly the Münster Basin in Germany, Poland, Iran, Algeria and Central Tunisia.

Family Turrilitidae Gill, 1871

Genus *Neostlingoceras* Klingler & Kennedy, 1978

Type species: *Turrilites carcitanensis* Matheron, 1842, p. 267, pl. 41, fig. 4, by the original designation of Kennedy & Klingler, 1978, p. 14.

***Neostlingoceras carcitanense* (Matheron, 1842)**

Pl. XXIV, fig. 10

1842. *Turrilites carcitanensis* Matheron, p. 267, pl. 41, fig. 4.
 1903. *Turrilites Morrisii* Sharpe.—Pervinquier, p. 69.
 1907. *Turrilites Morrisii* Sharpe.—Pervinquier, p. 99, pl. 4, figs 15-17; text-fig. 28.
 1994. *Neostlingoceras carcitanense* (Matheron, 1842).—Kennedy, p. 233.
 1994. *Neostlingoceras carcitanense* (Matheron, 1842).—Amédro in Robaszynski *et al.*, p. 415, pl. 16, figs 9, 10.
 1996. *Neostlingoceras carcitanense* (Matheron, 1842).—Wright & Kennedy, p. 326, pl. 99, figs 1-7, 9-15, 18, 19, 22, pl. 100, fig. 8; text-fig. 140b (with full synonymy).
 1998. *Neostlingoceras carcitanense* (Matheron, 1842).—Kaplan *et al.*, p. 194.
 2010. *Neostlingoceras carcitanense* (Matheron, 1842).—Amédro & Robaszynski, pl. 1, fig. 4.

Type: The holotype, by monotypy, is the original of Matheron, 1842, p. 267, pl. 41, fig. 4, from the remanié fauna of the Banc des Lombards at Cassis, Bouches-du-Rhône, France. This specimen was refigured by Fabre, 1940, pl. 5, fig. 7.

Material: An unregistered specimen in the Sorbonne Collections, the original of Pervinquier, 1907, pl. 4, fig. 17, from Djebel Mrhila, labelled 'marnes Inférieures Cen.'

Description: The specimen is a composite mould of three whorls with a maximum preserved whorl height of 18 mm. The apical angle is 14°. The outer, exposed whorl face is flattened, the inter-whorl sutures crenulated. There are 9-10 large tubercles at mid-flank, linked to the upper inter-whorl suture by one or two feeble ribs, with occasional ribs intercalated between, totalling 18-20 per whorl. The ribs efface to leave a smooth zone below the mid-lateral tubercles before strengthening on the lowest part to link to a row of sharp bullate tubercles, of which

there are 22 per whorl. A third row of slightly smaller tubercles lie at the junction of the outer and lower whorl faces, and are housed in crenulations in the inter-whorl suture. They give rise to single radial ribs that efface across the lower whorl face.

Discussion: See Wright & Kennedy (1996, p. 326); *N. carcitanense* differs from *N. oberlini* (Dubourdieu, 1953), described below, in having two, rather than three rows of small tubercles.

Occurrence: Lower Cenomanian *N. carcitanense* Subzone of the *M. mantelli* Zone. There are records from southern England, France, Germany, Poland, Turkmenistan, Kazakstan, Iran, Algeria, Central Tunisia, Kwa Zulul-Natal in South Africa, and Madagascar.

***Neostlingoceras oberlini* (Dubourdieu, 1953)**

1857. *Turrilites morrisii* Sharpe, p. 65 (*pars*), pl. 26, fig. 5 only.
 1953. *Hypoturrilites oberlini* Dubourdieu, p. 59, pl. 4, figs 28-30.
 1996. *Neostlingoceras oberlini* (Dubourdieu, 1953).—Wright & Kennedy, p. 328, pl. 99, figs 8, 16, 17, 24, 32, pl. 110, fig. 1, pl. 111, fig. 2, text-figs 129d, 137d, h, I, 142b, c (with full synonymy).
 1996. *Neostlingoceras oberlini* (Dubourdieu, 1953).—Kennedy in Gale *et al.*, p. 586, figs 110, 250 p, r.
 1998. *Neostlingoceras oberlini* (Dubourdieu, 1953).—Kaplan *et al.*, p. 198.

Type: Lectotype, designated by Wright & Kennedy, 1996, p. 329, is BGS GSM Geol. Soc. 7782, the original of Sharpe, 1857, pl. 26, fig. 5, from the phosphatic Lower Cenomanian *M. mantelli* Zone, *N. carcitanense* Subzone fauna of the Glauconitic Marl of Ventnor, Isle of Wight.

Material: OUM KX4059, from bed 2, 40-47 m above the base, Fom el Guelta.

Description: The specimen is a crushed limonitic fragment of a 180° whorl sector with a maximum preserved whorl height of 8 mm. The outer whorl face is flattened. There are four large, conical tubercles in the middle of the face, extended upwards in a short rib-like extension. There are six smaller tubercles low on the outer whorl face, a third row, displaced slightly adapturally, at the junction of outer and lower whorl faces, and a fourth row on the lower whorl face.

Discussion: Although only a fragment, the specimen exhibits the diagnostic features of the species; an upper row of fewer, larger tubercles, and three rows of more numerous, smaller tubercles below, whereas *N. carcitanense* has only two rows of smaller tubercles. The species is comprehensively reviewed by Wright & Kennedy (1996, p. 328).

Occurrence: Lower Cenomanian, *M. mantelli* Zone, *N. carcitanense* Subzone, southern England, France, Germany, Poland, Romania, Turkmenistan, Iran, Morocco, Algeria, Central Tunisia, Israel, KwaZulu-Natal in South Africa, Madagascar, and South India.

Genus and subgenus *Mariella* Nowak, 1916

Type species: *Turrilites bergeri* Brongniart, 1822, p. 395, pl. 7, fig. 3, by the original designation of Nowak, 1916, p. 10.

***Mariella (Mariella) bergeri* (Brongniart, 1822)**

Pl. XXIV, figs 14, 17

1822. *Turrilites bergeri* Brongniart, p. 395, pl. 7, fig. 3.
 1985. *Mariella (Mariella) bergeri* (Brongniart, 1822).– Atabekian, p. 27, pl. 2, figs 4, 5, pl. 3, figs 1-11, pl. 4, figs 1-7 (with synonymy).
 2009. *Mariella (Mariella) bergeri* (Brongniart, 1822). – Kennedy & Bilotte, p. 62, pl. 6, figs 31-44, ?45, pl. 7, figs 1-8, 10 (with additional synonymy).

Type: The holotype, by monotypy, is the original of Brongniart (1822, pl. 7, fig. 3), from the Montagne de Fiz, Savoie, France. The specimen has not been traced.

Material: OUM KX813-6, from south of Fom el Guelta.

Description: The specimens are poorly preserved, the most complete comprising two whorls; the maximum preserved whorl height is 35.8 mm. The upper whorl face is concave, with radial grooves to accommodate the ribs on the lower surface of the previous whorl, the junction between upper and outer whorl faces narrowly rounded, and crenulated to house the lowest row of tubercles of the previous whorl. The outer whorl face is convex, the junction of outer and lower whorl faces broadly rounded, the lower whorl face feebly convex. There are 24 ribs per whorl in OUM KX815 (Pl. XXIV, fig. 14). They are very feebly concave and prorsiradiate, linking to small transversely elongated tubercles just above mid-flank. A smooth zone separates them from a second row of conical to feebly transversely elongated tubercles, displaced aperturally. A second smooth zone separates this row from a third row of smaller conical to feebly transversely elongated tubercles, again displaced aperturally. A third smooth zone separates this row from the fourth row of tubercles, again displaced aperturally, and housed in notches in the junction of the outer and upper whorl faces of the succeeding whorl. They give rise to single radial ribs on the lower whorl face.

Discussion: Although poorly preserved, these specimens correspond well with specimens of similar size figured by Scholz (1979, pl. 8, figs 12, 14, 15, 17).

Occurrence: Upper Upper Albian *perinflatum* Zone where well-dated. Southern England, France, Switzerland, Germany, Spain, Sardinia, Hungary, Romania, Crimea, Caucasus, Turkmenistan, Kopet Dag, Iran, Morocco, Algeria, Central Tunisia, south India, KwaZulu-Natal in South Africa, Venezuela and California.

***Mariella (Mariella) cf. oehlerti* (Pervinquier, 1910)**

Pl. XXIV, figs 1-3

Compare:

1910. *Mariella (Mariella) oehlerti* Pervinquier, p. 53, pl. 14 (5), figs 14-17.
 1975. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Förster, p. 190, pl. 7, figs 7, 8, text-fig. 52.
 1978. *Mariella (Mariella) oehlerti oehlerti* (Pervinquier, 1910).– Klinger & Kennedy, p. 31, pl. 3, fig. e, pl. 4, fig. e, pl. 6, figs h-n, pl. 7, fig. g, pl. 8, figs g-h, text-figs 1a, b, 7b, d, 8g (with synonymy).
 1978. *Mariella (Mariella) oehlerti sulcata* Klinger & Kennedy, p. 33, pl. 3, fig. d, pl. 8, fig. d, text-figs 3d-e, 8h.
 ?1978. *Plesioturrilites oehlerti* (Pervinquier, 1910). – Young & Powell, pl. 8, figs 4, 6.
 ?1979. *Mariella (Mariella) cf. oehlerti* (Pervinquier).– Cooper & Kennedy, p. 233, text-fig. 34.
 1985. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Howarth, p. 79, text-figs 4, 6.
 1985. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Atabekian, p. 30, pl. 6, figs 4, 5.
 1996. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Wright & Kennedy, p. 341, text-fig. 138j, o, v.
 1999. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Matsumoto *et al.*, p. 109, text-figs 2-4.
 2000. *Mariella (Mariella) oehlerti* (Pervinquier, 1910).– Matsumoto *et al.*, p. 8, fig. 3.
 ?2011. *Mariella (Mariella) gr. oehlerti* (Pervinquier, 1910).– Meister *et al.*, p. 699, pl. 38, figs 3, 4, 6, pl. 39, figs 1-4.

Type: The holotype, by original designation is the original of Pervinquier, 1910, pl. 14 (5), figs 16, from Aumale, Algeria, an unregistered specimen in the Sorbonne Collections, refigured by Wright & Kennedy, 1996, text-fig. 138j.

Material: OUM KX4110-12 and 4115, from bed 3; OUM KX 4057 and possibly KX4128 from bed 4, Fom el Guelta. OUM KX1201, from the lower part of bed 3, south of Sif et Trella.

Description: The material consists of a series of tiny limonitic or calcitic individuals. The largest, and best-preserved, but crushed fragment is OUM KX4112 (Pl. XXIV, fig. 3), three whorls with a maximum preserved whorl height of 6.5 mm. The outer whorl face is convex in intercostal section. There are four rows of tubercles. Those in the upper row are the largest, situated around the middle of the outer, exposed whorl face, and numbering an estimated 16 per whorl. A second row of slightly smaller tubercles lies just above the inter-whorl suture. On the smallest whorl there are an estimated three to four more tubercles in this second row, on the largest whorl two more, to make an estimated 18 per whorl. A third row of tubercles is housed in notches in the inter-whorl suture, and a fourth row, close to the third, on the lower whorl face. OUM KX1201 (Pl. XXI, figs 1, 2) is a larger, crushed individual, with a maximum preserved whorl height of 9.5 mm. As with the previous specimen there are a few more tubercles in the lower three rows

than the upper row, and the third row of tubercles is housed in the inter-whorl suture.

Discussion: These specimens are compared with *M. (M.) oehlerti sensu lato* on the basis of the disposition of the tubercles, with only the upper two rows fully visible on the outer, exposed whorl face. They differ from the holotype in having fewer tubercles in the upper row of tubercles than in the lower three rows.

Occurrence: Lower Lower Cenomanian, Algeria, Central Tunisia, KwaZulu-Natal in South Africa, Madagascar, Angola, and, possibly, northern Mexico.

***Mariella (Mariella) aff. dorsetensis* Spath, 1926b**

Pl. XXIV, fig. 15

Compare:

1857. *Turrilites bergeri* Brongniart.– Sharpe, p. 65 (*pars*), pl. 26, figs 9, 11 only.

1926b. *Turrilites dorsetensis* Spath, pp. 429, 431.

1996. *Mariella (Mariella) dorsetensis* Spath, 1926.– Wright & Kennedy, p. 344, pl. 100, figs 5, 11, 17, 19, 22, 25; pl. 102, fig. 7; text-fig. 136b, e (with full synonymy).

Type: The holotype, by monotypy, is BMNH C3834, the original of Sharpe, 1857, pl. 26, fig. 11, refigured by Wright & Kennedy, 1996, pl. 100, fig. 5, from Chardstock, Devon.

Material: OUM KX2412, from the base of bed 7 south of Sif et Tella.

Description: The specimen consists of parts of three phragmocone whorls with a maximum preserved whorl height of 26 mm. The junction of the upper and outer whorl faces is crenulated to accommodate the lowest row of tubercles of the previous whorl. The outer whorl face is convex, the lower whorl face very feebly convex. The upper part of the outer whorl face is smooth. Below, there are four rows of tubercles, the tubercles of successive rows displace adapturally. The number of tubercles cannot be established because of the incompleteness of the specimen; there are four in a distance equal to the exposed whorl height. The tubercles of the first (upper) row and the second row are subequal, and rounded to slightly transversely elongated. The first row are slightly above the middle of the exposed whorl face, the second row are slightly below. The third row of tubercles are subequal to those of the previous rows, and lie towards the bottom of the exposed whorl face. The fourth row are smaller, and partially concealed in the notches in the inter-whorl contact zone.

Discussion: The holotype of *Mariella (M.) dorsetensis* consists of two whorls with a maximum whorl height of 10 mm, and is thus significantly smaller than the present specimen. The whorl shape and distribution of tubercles is comparable, but it and the small specimens figure by Wright & Kennedy all have a rib linking the upper row of tubercles to the inter-whorl suture, a feature not shown by the present specimen. Atabekian (1987, pl. 6, fig. 6)

referred a fragment of comparable size to the present material to *dorsetensis*; it too has a linking rib. Given this difference, the present identification is accordingly qualified.

Occurrence: *Mariella (M.) dorsetensis* occurs in the lower Lower Cenomanian *mantelli* Zone of southern England, northern France, Poland, Turkmenistan, Iran, Madagascar and Peru. The present specimen is from a comparable horizon.

Genus *Hypoturrilites* Dubourdieu, 1953

Type species: *Turrilites gravesianus* d'Orbigny, 1842, p. 596, pl. 144, figs 3-5, by original designation by Dubourdieu, 1953, p. 123.

***Hypoturrilites laevigatus* Coquand, 1862**

Pl. XXIV, fig. 18; Fig. 34A-D

1862. *Turrilites laevigatus* Coquand, p. 175, pl. 2, fig. 6.

1910. *Turrilites tuberculatoplicatus* var. *tenouklensis* Pervinquière, p. 57, pl. 15 (5), fig. 31.

1996. *Hypoturrilites laevigatus* (Coquand, 1862).– Wright & Kennedy, p. 373, pl. 102, fig. 2; text-fig. 146 K-M, P, Q (with full synonymy).

Types: The holotype, by monotypy is the original of Coquand 1862, p. 175, pl. 2, fig. 6, no. K8380 in the collections of the National Museum of Natural History, Budapest, illustrated here as Text-fig. 34A-B. It is from Tenoukla, Algeria. The holotype, by monotypy, of *Turrilites tuberculatoplicatus* var. *tenouklensis* Pervinquière, 1910, p. 57, pl. 15 (5), fig. 31 is an unregistered specimen in the Sorbonne Collections, and also from Tenoukla. It is illustrated here as Fig. 34C, D.

Material: OUM KX2036, from bed 9, Foum el Guelta.

Description: The holotype (Text-fig. 34A, B) is a very worn specimen. The outer whorl face is broadly rounded. The surface is very worn and corroded, with traces of ten large, rounded tubercles in the middle of the face. The lower part of the outer, exposed whorl face bears two rows of smaller, more numerous spirally elongated tubercles, each row borne on a spiral ridge. The lower row are separated from the upper row by a narrow spiral groove, and concealed below the inter-whorl suture. The convex lower whorl face bears a corresponding number of weak radial ribs, the upper concave whorl face a series of radial grooves to accommodate the ribs on the lower face of the preceding whorl. OUM KX2036 (Pl. XXIV, fig. 18) is equally poorly preserved, a 240° sector of phragmocone and a 180° sector from the adapical end of the body chamber. The maximum diameter of the spire is 71 mm, the maximum preserved whorl height is 43 mm. The upper whorl face is concave, with radial grooves to accommodate the radial ribs on the base of the preceding whorl. The junction of the upper and outer whorl faces is narrowly rounded, and crenulated.

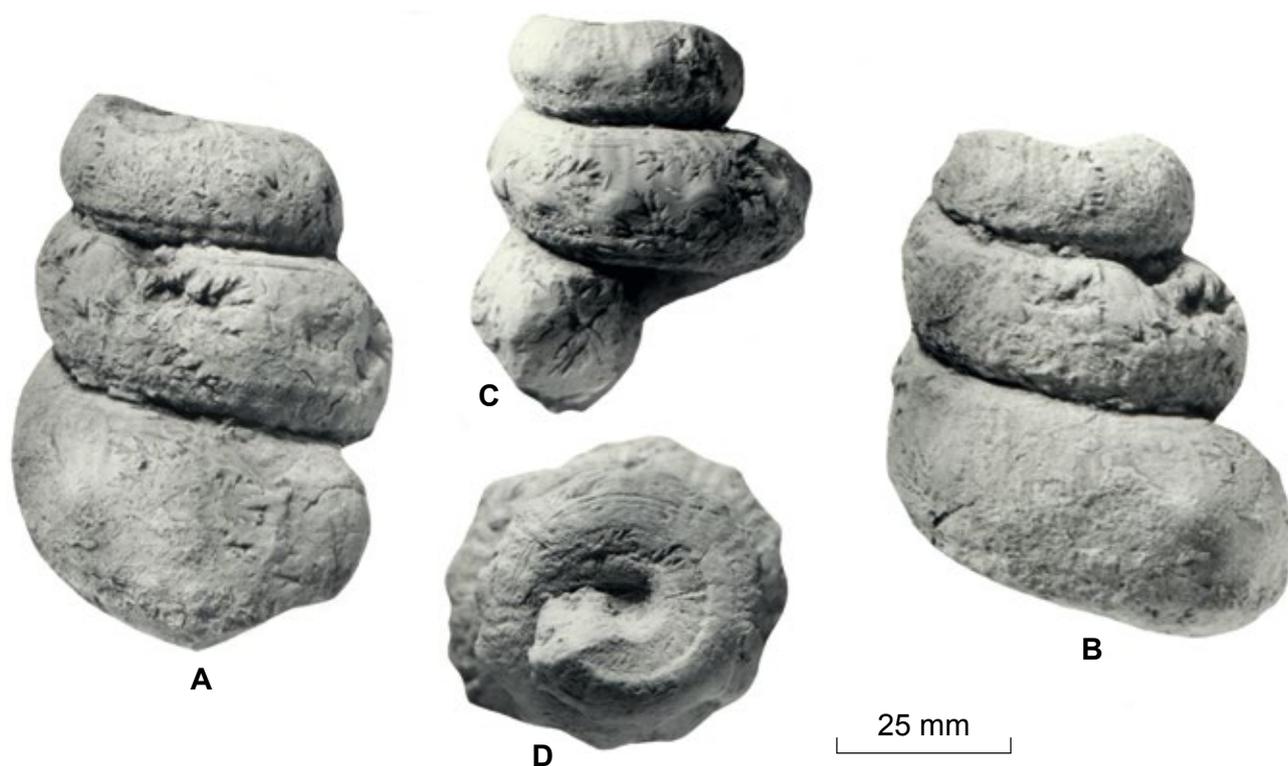


Fig. 34: *Hypoturrites laevigatus* (Coquand, 1862.) A, B: the holotype, the original of Coquand, 1862, p. 175, pl. 2, fig. 6, no. K8380 in the collections of the National Museum of Natural History, Budapest, from Tenoukla, Algeria. C, D: holotype of *Turritites tuberculatoplicatus* var. *tenouklensis* Pervinquier, 1910, p. 57, pl. 15 (5), an unregistered specimen in the Sorbonne Collections, and also from Tenoukla.

The outer whorl face is convex. There are six large, low, rounded, barely detectable tubercles per half whorl on the middle of the face. Traces of concave prorsiradiate ribs arise at the junction of upper and outer whorl faces, and link in groups of three at the tubercles, with occasional ribs intercalating between. There are traces of two rows of more numerous, spirally elongated tubercles on the lower part of the outer whorl face, the lower close to the junction of outer and lower whorl faces.

Discussion: The holotype and the present specimen, both with ornament very poorly preserved, are distinguished by the combination of numerous feeble ribs, few, weak, tubercles in the middle of the outer whorl face, and only two rows of spirally elongated tubercles below. This pattern of ornamentation is that seen in the holotype of *Hypoturrites tuberculatoplicatus* var. *tenouklensis* (Pervinquier, 1907) [p. 57, pl. 14 (5), fig. 31] which is from the same locality as the holotype of *laevigatus*, is better-preserved, and clarifies the distinguishing features of the species; it is illustrated here as Fig. 34C-D. It is a wholly septate internal mould of just over two whorls, with a maximum preserved whorl height of 25 mm. The upper whorl face is concave, the junction between upper and outer whorl faces narrowly rounded, the outer whorl face markedly convex, and merging with the broadly rounded lower whorl face. The upper whorl face is ornamented by crowded narrow, delicate, rounded

ribs that strengthen across the junction of upper and outer whorl faces and sweep forwards across the outer whorl face in a feebly sinuous course such that they are feebly convex above, and feebly concave below. There are fourteen large, flat-topped tubercles per whorl in the middle of the outer whorl face. The ribs link in groups of two or three at these tubercles, and intercalate between. The ribs link to a row of numerous small oblique clavi, borne on a spiral ridge low on the whorl face. A third row of spirally elongated tubercles, displaced adaperturally with respect to the second row, lie at the junction of outer and lower whorl faces. They give rise to radial prorsiradiate ribs on the lower whorl face.

Hypoturrites laevigatus most closely resembles *Hypoturrites tuberculatoplicatus* (Seguenza, 1882) from the Cenomanian of San Giorgio, near Brancaleone, Calabria, Italy. The species is revised by Wright & Kennedy (1996, p. 374, pl. 108, fig. 7, pl. 113, figs 3, 4, 6, 8, 9). It resembles *H. laevigatus* in the combination of ribs and tubercles, but differs in the presence of a third row of small tubercles, making four rows in all, rather than three, as in the present species.

Occurrence: Lower Cenomanian of southern England and Azerbaijan, lower Middle Cenomanian of Algeria and Central Tunisia.

***Hypoturrilites* sp. juv. cf. *gravesianus*
(d'Orbigny, 1841)**

Compare:

1842. *Turrilites gravesianus* d'Orbigny, p. 596, pl. 144, figs 3-5.
 1996. *Hypoturrilites gravesianus* (d'Orbigny, 1842).— Wright & Kennedy, p. 364, pl. 102, fig. 10, pl. 109, figs 1-6, pl. 110, figs 2, 8, 9, pl. 111, fig. 6, pl. 112, figs 1, 3, pl. 113, figs 1, 2, 5, 7, 10-12, text-figs 134r, 140j, k, 141e; 145f, 147e-g (with full synonymy).
 1998. *Hypoturrilites gravesianus* (d'Orbigny, 1842).— Kaplan *et al.*, p. 218, pl. 61, figs 1, 2, pl. 63, figs 12-14.

Type: The lectotype (International Commission on Zoological Nomenclature Opinion, 1925, 1999) is BMNH C5762b, the original of Mantell, 1822, pl. 24, fig. 6, from the Lower Chalk of Middleham, near Ringmer, Sussex.

Material: OUM KX1955, from bed 8 of the Fom el Guelta section.

Description and Discussion: A fragment of two half whorls has a maximum preserved whorl height of 18 mm, with six large tubercles per half whorl in the middle of the outer whorl face, and three rows of more numerous small tubercles below. The density of the large tubercles in the upper row suggests comparison with *Hypoturrilites gravesianus*. The closely related *H. tuberculatus* (Bosc, 1801) (see revision in Wright & Kennedy, 1996, p. 367, pl. 102, figs 1, 13, 15, pl. 110, fig. 6, pl. 111, figs 4, 5, 7, pl. 112, figs 2, 4, pl. 113, fig. 13, text-figs 137a, 144c, d) has more and smaller tubercles in the upper row: 20 per whorl versus 12 in *gravesianus*.

Occurrence: Lower Cenomanian, England, France, Spain, Switzerland, Germany, Poland, Romania, Iran, Turkmenistan, Kazakhstan, Morocco, Algeria, Central Tunisia, KwaZulu-Natal in South Africa, Madagascar, Northern Australia, the U.S. Gulf Coast region, and Argentina.

Genus *Turrilites* Lamarck, 1801

Type species: *Turrilites costatus* Lamarck, 1801, p. 102, by original designation.

***Turrilites scheuchzerianus* Bosc, 1801**

Pl. XXIV, figs 6-8, 11-13, 16, 19

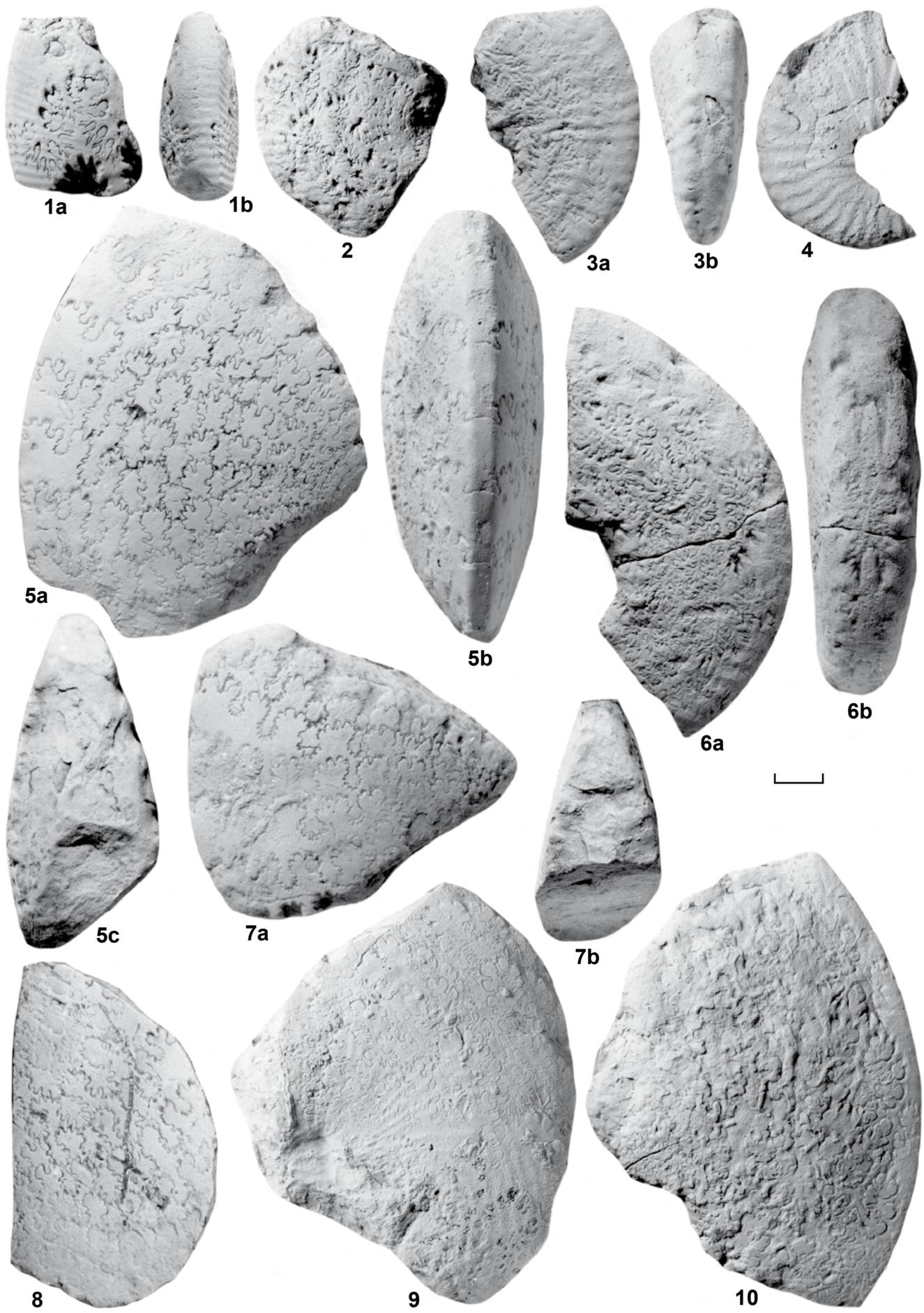
1708. *Turbinites* Langius, p. 112, fig. 6.
 1801. *Turrilites scheuchzerianus* Bosc in Buffon, p. 190 (copy of Langius)
 1996. *Turrilites scheuchzerianus* Bosc, 1801.— Wright & Kennedy, p. 349, pl. 106, figs 7, 8, 11, 12, pl. 107, figs 1-7, text-figs 137g, j, 138c, d, f, g, h, i, n, 139d-i, 140a, d, e, f, g, h, i, 143h, 147a, b (with full synonymy).
 1997b. *Turrilites (Turrilites) scheuchzerianus* Bosc, 1801.— Wilmsen, pl. 1, fig. 3.
 1998. *Turrilites scheuchzerianus* Bosc.— Kaplan *et al.*, p. 213, pl. 59, figs 12-14, pl. 64, figs 4, 7, 10, 11, pl. 65, figs 1-3, 6 (with additional synonymy).
 1999. *Turrilites scheuchzerianus* Bosc.— Hayakawa & Nishino, p. 11, pl. 10, figs a, b, c, e, f.
 2004. *Turrilites scheuchzerianus* Bosc, 1801.— Amédro in Robaszynski *et al.*, p. 416, pl. 13, fig. 9.
 2004. *Turrilites costatus* Lamarck, 1801.— Amédro in Robaszynski *et al.*, p. 416, pl. 13, figs 5, 7.
 2013. *Turrilites scheuchzerianus* Bosc.— Reboulet *et al.*, text-fig. 5c.
 2013. *Turrilites scheuchzerianus* Bosc, 1801. — Kennedy *et al.*, p. 649, pl. 9, figs 1-3.
 ?2013. *Turrilites* cf. *scheuchzerianus* Bosc, 1801.— Wilmsen *et al.*, p. 506, text-fig. 10a.
 2014. *Turrilites scheuchzerianus* Bosc, 1801.— Walaszczyk *et al.*, text-fig. 24c, d.

Type: Bosc's figure is a copy of Langius, 1708, pl. 112, fig. 6. The status and whereabouts of the type material of this species has not been established.

Material: OUM KX2012-2016, 2037-2041, from bed 9; OUM KX1943-1948, collected loose *ex* bed 9, Fom el Guelta. OUM KX1389-1394, 3123-3149 from bed 8, south of Sif et Tella.

Plate I

- Fig. 1: *Forbesiceras* cf. *beaumontianum* (d'Orbigny, 1841), OUM KX1970, from bed 5, Fom el Guelta.
 Fig. 2: *Forbesiceras* cf. *beaumontianum* (d'Orbigny, 1841), OUM KX2415, from the base of bed 7, south of Sif et Tella.
 Fig. 3: *Graysonites azregensis* (Amédro, 1994), OUM KX2414, from the base of bed 7, south of Sif et Tella.
 Fig. 4: *Graysonites azregensis* (Amédro, 1994), OUM KX1959, from bed 3, Fom el Guelta.
 Fig. 5: *Placenticeras saadense* Thomas & Peron, 1890, Original of Pervinquièrre, 1907, p. 198, text-fig. 76, SP unregistered, *ex* Pervinquièrre Collection, from 'Kef et Tella' (=Kef Si Abd el Kader).
 Fig. 6: *Graysonites azregensis* (Amédro, 1994), OUM KX2416, from the base of bed 7, south of Sif et Tella.
 Fig. 7: *Placenticeras saadense* Thomas & Peron, 1890, Neotype, MNHP R52073, the original of Peron, 1890, pl. 16, figs 5-7, from Djebel Meghila.
 Fig. 8: *Placenticeras saadense* Thomas & Peron, 1890, MNHP R52064, the original of Thomas & Peron, 1890, pl. 16, figs 3, 4, from Djebel Meghila.
 Fig. 9: *Forbesiceras obtectum* (Sharpe, 1853), SP unregistered *ex* Flick Collection, from Fom el Guelta.
 Fig. 10: *Forbesiceras* cf. *obtectum* (Sharpe, 1853), SP unregistered *ex* Flick Collection, from Fom el Guelta.
 (Bar scale is 10 mm)



Description: *Turrilites scheuchzerianus* is the commonest ammonite in the Djebel Mrhila successions. Body fragments range up to 40 mm whorl height. The fragmentary material illustrates the two successive ontogenetic stages of the species. The first stage is well shown by OUM KX3140 (Pl. XXIV, fig. 7), OUM KX1947 (Pl. XXIV, fig. 11) and OUM KX2013 (Pl. XXIV, fig. 13). The upper whorl face is feebly concave, with shallow radial grooves on the outermost part. The junction between upper and outer whorl faces is very narrowly rounded, the upper and lower parts of outer whorl face convex, the face flattened between. Strong, even, prorsiradiate ribs arise at the upper inter-whorl suture and number from 19-26 per whorl. They sweep forwards across the outer whorl face, and are interrupted and weakened just below mid-flank by a spiral groove, before strengthening again and extending down to just above the base of the outer exposed whorl face, where they are interrupted by a second, less conspicuous groove, beyond which they strengthen once more before effacing and leaving the greater part of the lower whorl face smooth. The second ontogenetic stage occupies up to three whorls of body chamber in the present fragments (Pl. XXIV, figs 8, 12, 16), and is characterised by the disappearance of the spiral grooves. The change from the first to second growth stage occurs at different whorl heights. As a result, there are fragments of the same whorl height with grooves (Pl. XXIV, fig. 13) and without (Pl. XXIV, fig. 11, lower whorl). This is a reflection of the size dimorphism shown by the species (Wright & Kennedy, 1996, p. 351).

Discussion: The absence of tubercles and the entire ribs of adults are distinctive, and easily separate the species from *Turrilites costatus* Lamarck, 1801, and *T. acutus* Passy, 1832, as discussed by Wright & Kennedy (1986).

Occurrence: Upper Lower and Middle Cenomanian. There are records from Bornholm in the Baltic, England, France, Switzerland, Germany, Poland, Spain, southern Italy, Crimea, Iran, Kazakhstan, Turkmenistan, Iran, Morocco, Algeria, Central Tunisia, Israel, Nigeria, KwaZulu-Natal in South Africa, Madagascar, Tibet, Japan, the U.S. Gulf Coast and Western Interior.

Turrilites costatus Lamarck, 1801

Pl. XXIV, figs 5, 9

1801. *Turrilites costatus* Lamarck, p. 102 (*pars*).
 non 1994. *Turrilites costatus* Lamarck, 1801.– Amédéo in Robaszynski *et al.*, p. 416, pl. 13, figs 5, 7 (= *Turrilites scheuchzerianus* Bosc, 1801).
 1996. *Turrilites costatus* Lamarck, 1801.– Wright & Kennedy, p. 354, pl. 103, figs 1, 2, 5, pl. 104, figs 1-4, 6, 8-10, pl. 105, figs 1, 5, 6, 10, 12, 13, 16, 17, 19, pl. 106, figs 1-6, 9, 10, text-figs 137c, 139a-c; 142a, f, g, 143a-g, i-p (with full synonymy).
 1998. *Turrilites costatus* Lamarck, 1801.– Kaplan *et al.*, p. 214, pl. 64, fig. 3; pl. 65, figs 7, 8.
 1999. *Turrilites costatus* Lamarck, 1801.– Hayakawa *et al.*, p. 10, pl. 10, fig. 4.
 2010. *Turrilites costatus* Lamarck, 1801.– Amédéo & Robaszynski, pl. 2, figs 2, 3.

Type: The lectotype, by the subsequent designation of Kennedy, 1971, p. 30, is the specimen from Rouen figured by R. Douvillé (1904, fiche 54a, fig. 1) in the Lamarck Collection, housed in the Laboratoire de Malacologie of the Muséum National d'Histoire Naturelle, Paris. It was refigured by Wright & Kennedy (1996, text-fig. 142f).

Material: OUM KX324/1-2, from bed 10 of the Sif et Tella section.

Description: OUM KX324/2 (Pl. XXIV, fig. 5) consists of two whorls, the maximum preserved whorl height 10 mm approximately. The upper whorl face is concave and smooth, the outer whorl face broadly convex in intercostal section. There are 10 ribs per half whorl. They are strong, straight, very feebly prorsiradiate, and as wide as the interspaces. They extend to just below the middle of the outer, exposed whorl face, where they strengthen into a blunt tubercle immediately above a prominent spiral groove across which the ribs efface, before strengthening into a row of smaller rounded tubercles, separated by a second, less conspicuous groove from a third row of feeble, spirally elongated tubercles, partially concealed in the inter-whorl suture. OUM KX324/1 (Pl. XXIV, fig. 9) is a larger fragment, with a maximum preserved whorl height of 16 mm. There are 10 ribs per half whorl, with three rows of tubercles, as in the previous specimen, the tubercles in the upper row sharper.

Plate II

- Fig. 1: *Neolobites peroni* Pervinquier, 1907, OUM KX3236, from bed 10, south of Sif et Tella.
 Fig. 2: *Neolobites peroni* Pervinquier, 1907, OUM KX3234, from bed 10, south of Sif et Tella.
 Fig. 3: *Neolobites peroni* Pervinquier, 1907, OUM KX2010, from bed 9, Foum el Guelta
 Fig. 4: *Neolobites peroni* Pervinquier, 1907, OUM KX3119, from bed 8, south of Sif et Tella.
 Fig. 5: *Neolobites peroni* Pervinquier, 1907, OUM KX3233, from bed 10, south of Sif et Tella.
 Fig. 6: *Neolobites peroni* Pervinquier, 1907, OUM KX3235, from bed 10, south of Sif et Tella.
 Fig. 7: *Neolobites peroni* Pervinquier, 1907, OUM KX3120, from bed 8, south of Sif et Tella.
 (Bar scale is 10 mm)



1a



1b



2a



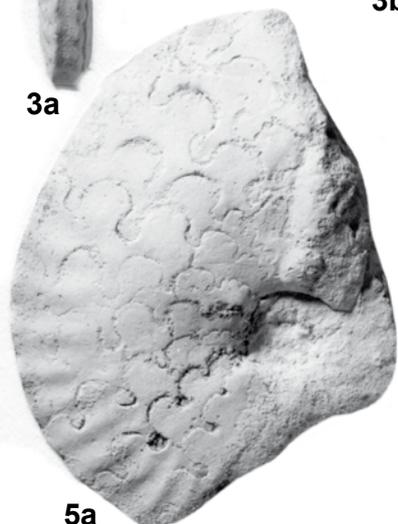
2b



3b



3a



5a



5b



4a



4b



6a



6b



7a



7b

Discussion: The presence of three rows of well-differentiate tubercles separate these specimens from *Turrilites scheuchzeriaus* of the same size (compare Pl. XXIX, figs 6 and 7 with figs 5 and 9). In *Turrilites acutus* Passy, 1832 (see below, and revision in Wright & Kennedy, 1996, p. 358, pl. 103, fig. 3, pl. 104, figs 5, 7, 11, pl. 105, fig. 21, pl. 108, figs 1-4, 8, 11, 12, text-figs 138m, 141a, 146n-o), which succeeds *Turriites costatus*, ornament consists of three rows of tubercles linked by no, or only a feeble rib, whereas in *costatus* well-developed ribs extend across the upper half of the outer, exposed whorl face.

Occurrence: Index of the lower Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone, extending as a rarity into the upper Middle and lower Upper Cenomanian, although the latter records from condensed basement beds in Western Europe may be remanié individuals. The geographic distribution extends to England, France, Germany, Switzerland, Poland, Spain, Portugal, Romania, Crimea, Russia, Kazakhstan and Kopet Dag, Turkmenia, Iran, Algeria, Central Tunisia, the Middle East, Nigeria, Angola, KwaZulu-Natal South Africa, Mozambique, Madagascar, South India, Tibet, northern Australia, Mexico, the U.S. Gulf Coast and California.

Turrilites acutus Passy, 1832

1832. *Turrilites acutus* Passy, p. 9, pl. 16, figs 3, 4.
 1994. *Turrilites acutus* Passy.– Amédéo in Robaszynski *et al.*, p. 416, pl. 13, fig. 8.
 1996. *Turrilites acutus* Passy.– Wright & Kennedy, p. 358, pl. 103, fig. 3, pl. 104, figs 5, 7, 11, pl. 105, fig. 21, pl. 108, figs 1-4, 8, 11, 12, text-figs 138m, 141a, 146n-o (with full synonymy).
 1997. *Turrilites acutus* Passy.– Hayakawa & Nishino, p. 11, pl. 10, fig. 1.
 1998. *Turrilites acutus* Passy. – Kaplan *et al.*, p. 216, pl. 60, fig. 4, pl. 63, figs 1-5, pl. 64, fig. 2.

2011. *Turrilites acutus* Passy.– Kennedy *et al.*, p. 231, text-fig. 20.

Type: The lectotype by the subsequent designation of Juignet & Kennedy, 1976, p. 65, is the original of Passy, 1832, pl. 16, fig. 3, an unregistered specimen in the Sorbonne Collections. It is from the Middle Cenomanian of Rouen, Seine-Maritime, France, and was refigured by Kennedy & Juignet (1976, pl. 4, fig. 2) and Wright & Kennedy (1996, pl. 108, fig. 8).

Discussion: We have not collected this species ourselves, but noted two unregistered specimens collected by Flick in the Sorbonne Collections from Foum el Guelta, possibly those mentioned by Pervinquier (1907, p. 96 under *Turriites costatus*).

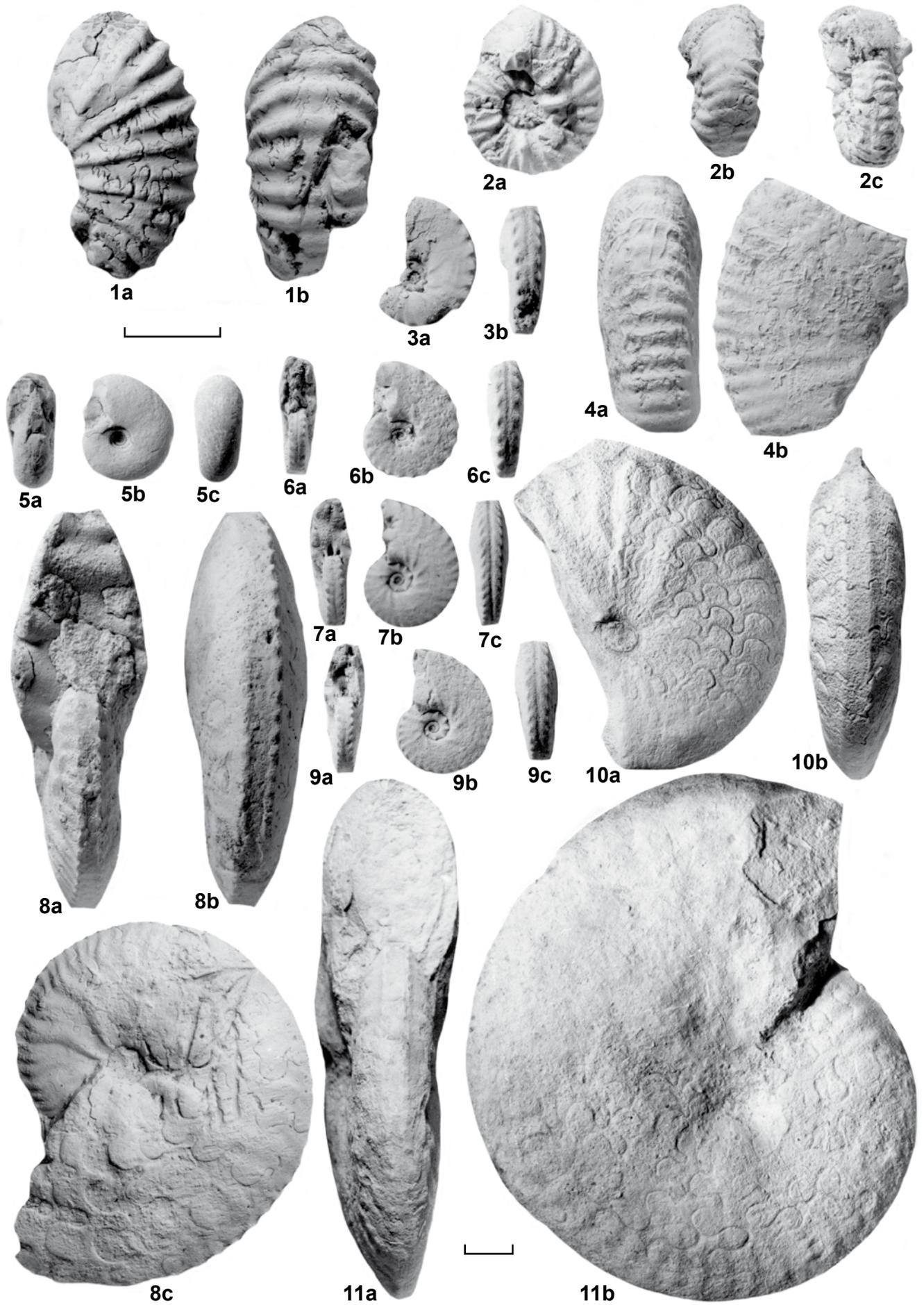
Occurrence: Middle Cenomanian, index of the upper Subzone of the *Acanthoceras rhotomagense* Zone to lower Upper Cenomanian *Calycoceras guerangeri* Zone. The geographic distribution extends from England to France, Germany, Poland, Spain, northern Russia, Kazakhstan, Turkmenia, Iran, Algeria, Central Tunisia, Israel, Nigeria, Angola, KwaZulu-Natal in South Africa, Madagascar, Tibet, Texas, the U.S. Western Interior and California.

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Plate III

- Fig. 1: *Mantelliceras lymense* (Spath, 1926), OUM KX1975, from bed 5, Foum el Guelta.
 Fig. 2: *Euhystrochoceras (Sakondryella) remolinense* (Böse, 1928), OUM KX1942, collected loose, but from the Lower Cenomanian part of the succession, Foum el Guelta.
 Fig. 3: *Hyphoplites falcatus* (Mantell, 1822) *aurora* Wright & Wright, 1949, OUM KX1203, from bed 3 south of Sif et Tella.
 Fig. 4: *Stoliczkaella (Stoliczkaella) dispar* (d'Orbigny, 1841), SP unregistered, ex Pervinquier Collection, mentioned by Pervinquier, 1907, pp. 389, 391 ('Forme normale'), 'Sommet zone *inflatum*. G de la coupe.' Djebel Mrhila.
 Fig. 5: *Desmoceras (Desmoceras)* sp. juv. cf. *latidorsatum* (Michelin, 1838), OUM KX4085, from bed 3, Foum el Guelta.
 Fig. 6: *Hyphoplites falcatus* (Mantell, 1822) *aurora* Wright & Wright, 1949, OUM KX4091, bed 3, Foum el Guelta.
 Fig. 7: *Hyphoplites falcatus* (Mantell, 1822) *aurora* Wright & Wright, 1949, OUM KX4092, bed 3, Foum el Guelta.
 Fig. 8: *Neolobites peroni* Hyatt, 1903, OUM KX1885, from the base of bed 19, Foum el Guelta.
 Fig. 9: *Hyphoplites falcatus* (Mantell, 1822) *aurora* Wright & Wright, 1949, OUM KX4091, from bed 3, Foum el Guelta.
 Fig. 10: *Neolobites* aff. *peroni* Hyatt, 1903, SP unregistered, ex Schlumberger Collection, 'route de Batna a Biskra', Batna Province, Algeria.
 Fig. 11: *Neolobites peroni* Hyatt, 1903, the holotype, MNHP collections, from Djebel Romana (?), original of *Neolobites Vibrayeanus* d'Orbigny of Thomas & Peron, 1890, pl. 18, fig. 1.
 (Figs 1, 2, 4, 8, 10, 11: lower bar scale is 10 mm; figs 3, 5-7, 9: upper bar scale is 10 mm)



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Plate IV

- Fig. 1: *Stoliczkaella (Stoliczkaella) dispar* (d'Orbigny, 1841), SP unregistered, ex Pervinquier Collection, mentioned by Pervinquier, 1907, pp. 389, 391 ('Forme normale'), 'Sommet zone *inflatum* G de la coupe.' Djebel Mrhila.
- Fig. 2: *Forbesiceras cf. obtectum* (Sharpe, 1853), OUM KX1915, from bed 13, Fom el Guelta.
- Fig. 3: *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922), SP unregistered, ex Pervinquier Collection, mentioned by Pervinquier [1904, p. 64; 1907, p. 229 (*pars*)], from unit 1 of Pervinquier (1904, text-fig. 14), Kef Si Abd el Kader (Kef et Tella).
- Fig. 4: *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922), SP unregistered, ex Pervinquier Collection, mentioned by Pervinquier [1904, p. 64; 1907, p. 229 (*pars*)], from unit 1 of Pervinquier (1904, text-fig. 14), Kef Si Abd el Kader (Kef et Tella).
- Fig. 5: *Stoliczkaia (Lamnayella) cf. sanctaetherinae* Wright & Kennedy, 1978, OUM KX1983, from bed 5, south of Sif et Tella.
- Fig. 6: *Mortoniceras (Subschloenbachia) perinflatum* (Spath, 1922), SP unregistered, ex Pervinquier Collection, mentioned by Pervinquier [1904, p. 64; 1907, p. 229 (*pars*)], from unit 1 of Pervinquier (1904, text-fig. 14), Fom el Guelta.
- (Bar scale is 10 mm)



1a



1b



2a



2b



3a



4a



4b



5a



5b



3b



6a

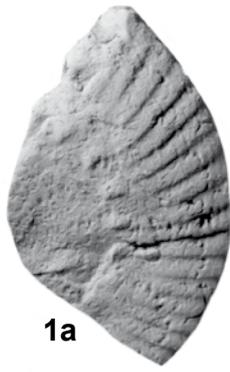


6b

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Plate V

- Fig. 1: *Forbesiceras chevillei* (Pictet & Renevier, 1866), OUM KX3177, from bed 8 south of Sif et Tella.
- Fig. 2: *Forbesiceras chevillei* (Pictet & Renevier, 1866), OUM KX3178, from bed 8 south of Sif et Tella.
- Fig. 3: *Forbesiceras flicki* Pervinquière, 1907, the holotype, SP unregistered, ex Flick Collection, the original of Pervinquière, 1907, p. 112, pl. 5, fig. 12, from Foum el Guelta.
- Fig. 4: *Forbesiceras obtectum* (Sharpe, 1853), SP unregistered, ex Pervinquière Collection, the original of Pervinquière, 1907, p. 108, pl. 5, fig. 11, from Foum el Guelta.
- Fig. 5: *Forbesiceras flicki* Pervinquière, 1907, OUM KX3238, from bed 10, south of Sif et Tella.
- Fig. 6: *Forbesiceras chevillei* (Pictet & Renevier, 1866), OUM KX2034, from bed 9, Foum el Guelta.
- Fig. 7: *Forbesiceras* cf. *obtectum* (Sharpe, 1853), OUM KX1881, from the base of bed 19, Foum el Guelta.
- (Bar scale is 10 mm)



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Plate VI

- Fig. 1: *Mrhiliceras lapparenti* (Pervinquier, 1907), the holotype, SP unregistered, ex Pervinquier Collection, the original of Pervinquier, 1907, pl. 14, fig. 5, from Ain el Glaa, Djebel Bireno.
- Fig. 2: *Mrhiliceras lapparenti* (Pervinquier, 1907), a paratype, SP unregistered, ex Pervinquier Collection, the original of Pervinquier, 1907, pl. 14, fig. 6, from Ain el Glaa, Djebel Bireno.
- Fig. 3: *Mrhiliceras lapparenti* (Pervinquier, 1907), OUM KX1999, collected loose, but derived from beds 14-17, Fom el Guelta.
- Fig. 4: *Mrhiliceras lapparenti* (Pervinquier, 1907), a paratype, SP unregistered, ex Pervinquier Collection, from Fom el Guelta.
- Fig. 5: *Mrhiliceras lapparenti* (Pervinquier, 1907), OUM KX1993, from beds 14-17, Fom el Guelta.
- Fig. 6: *Mrhiliceras lapparenti* (Pervinquier, 1907), a paratype, SP unregistered, ex Pervinquier Collection, from Kef Si Abd el Kader.
- Fig. 7: *Mrhiliceras lapparenti* (Pervinquier, 1907), OUM KX2000, from the base of bed 14, Fom el Guelta.
- Fig. 8: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX3161, from bed 8, south of Sif et Tella.
- (Bar scale is 10 mm)



1a



1b



1c



2a



2b



3a



4a



4b



5a



5b



3b



6a



8a



8b



7

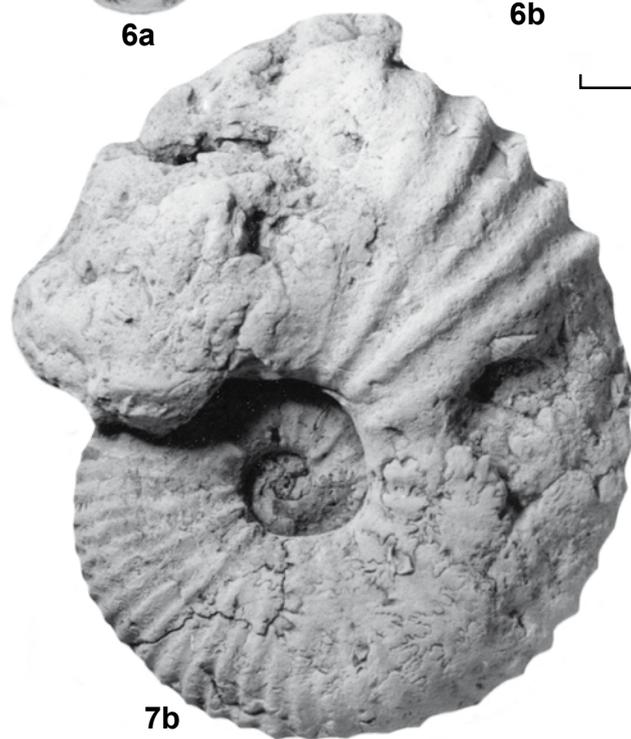


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Plate VII

- Fig. 1: *Mantelliceras lymense* (Spath, 1926b), SP unregistered, ex Pervinquier Collection, from Sif et Tella.
- Fig. 2: *Mantelliceras couloni* (d'Orbigny, 1850); OUM KX1052, from bed 5, south of Sif et Tella.
- Fig. 3: *Mantelliceras mantelli* (J. Sowerby, 1814), OUM KX2409, from the base of bed 7, south of Sif et Tella.
- Fig. 4: *Mantelliceras saxbii* (Sharpe, 1857), SP unregistered, ex Pervinquier Collection, from Kef Si Abd el Kader (Kef et Tella).
- Fig. 5: *Mantelliceras couloni* (d'Orbigny, 1850); OUM KX1067, from bed 5, south of Sif et Tella.
- Fig. 6: *Mantelliceras lymense* (Spath, 1926b), OUM KX1192, from bed 5, south of Sif et Tella.
- (Bar scale is 10 mm)



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Plate VIII

- Fig. 1: *Mantelliceras mantelli* (J. Sowerby, 1814), OUM KX1928, from the base of bed 7, Foum el Guelta.
- Fig. 2: *Mantelliceras lymense* (Spath, 1926b), OUM KX1921, from the base of bed 7, Foum el Guelta.
- Fig. 3: *Mantelliceras couloni* (d'Orbigny, 1850); OUM KX1961a, from bed 3, Foum el Guelta.
- Fig. 4: *Mantelliceras saxbii* (Sharpe, 1857), SP unregistered, ex Pervinquier Collection, from Kef Si Abd El Kader.
- Fig. 5: *Mantelliceras mantelli* (J. Sowerby, 1814), OUM KX2398, from the base of bed 7, south of Sif et Tella.
- Fig. 6: *Mantelliceras lymense* (Spath, 1926b), MNHP R52345, from Djebel Mrhila.
- (Bar scale is 10 mm)



1a



1b



2a



2b



3a



3b



4a



4b



5a



6a



6b



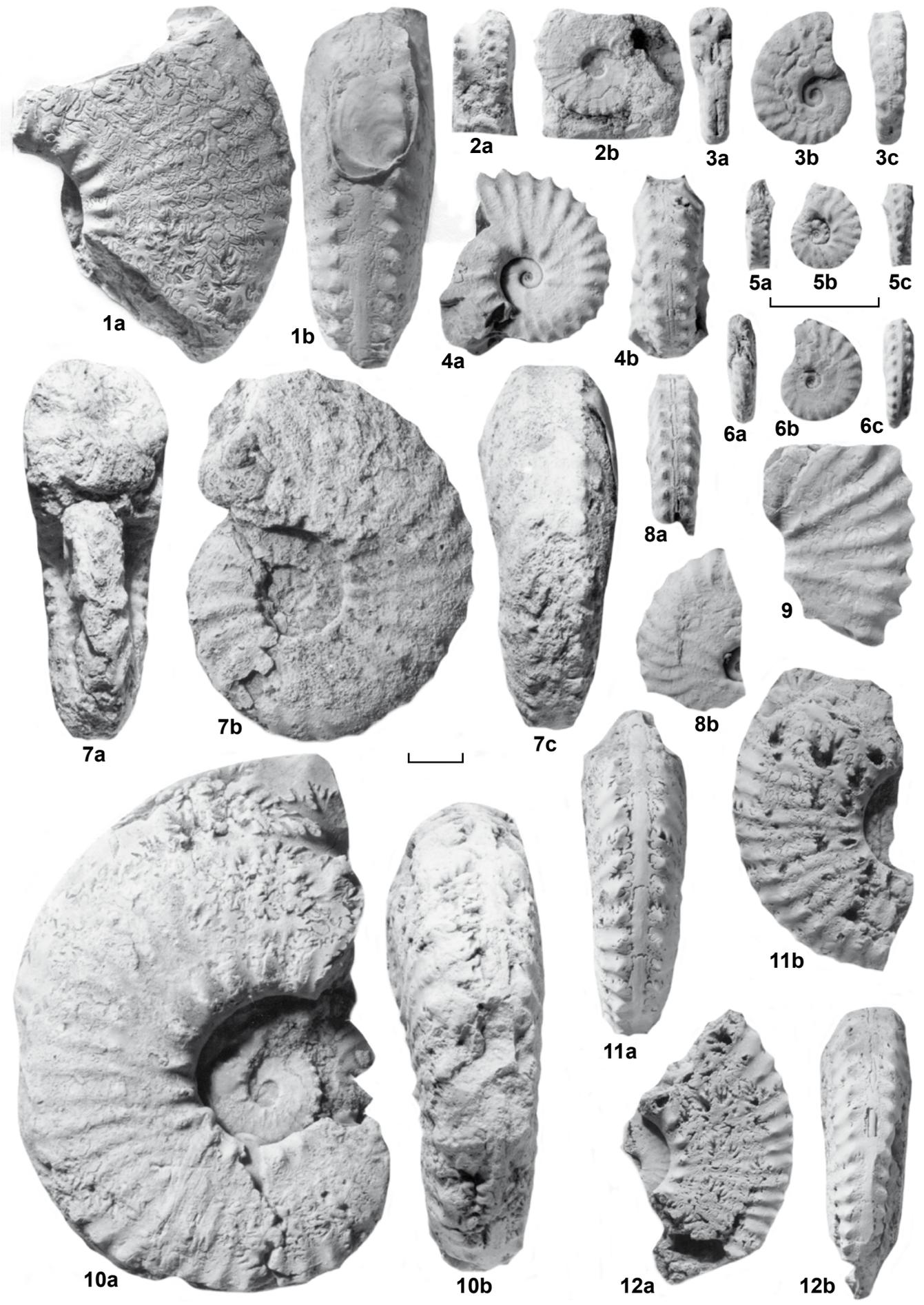
5b



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Plate IX

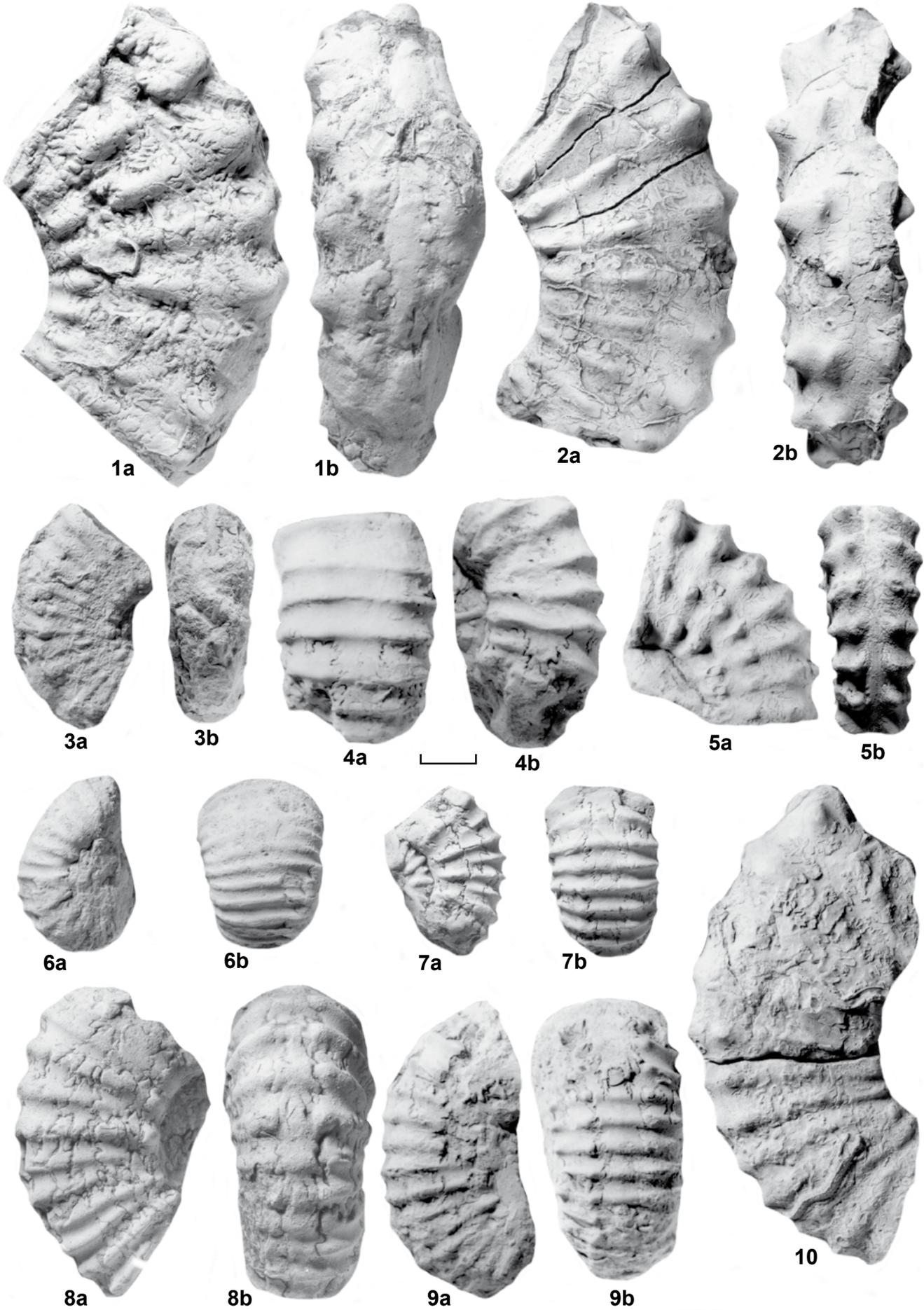
- Fig. 1: *Graysonites cherbensis* (Thomas & Peron, 1889), SP unregistered ex Aubert Collection, the original of *Sharpiceras laticlavium* var. *byzacenica* Pervinquier, 1907, p. 301, pl. 16, fig. 4, from Djebel Rebeiba.
- Fig. 2: *Graysonites cherbensis* (Thomas & Peron, 1889), MNHP R52350a, from Djebel Mrhila (see also fig. 10).
- Fig. 3: *Graysonites cherbensis* (Thomas & Peron, 1889), OUM KX4054, bed 2, 23-28m above the base, Foum el Guelta.
- Fig. 4: *Graysonites cherbensis* (Thomas & Peron, 1889), OUM KX4094, bed 3, Foum el Guelta.
- Fig. 5: *Graysonites cherbensis* (Thomas & Peron, 1890), OUM KX4095, bed 3, Foum el Guelta.
- Fig. 6: *Graysonites cherbensis* (Thomas & Peron, 1889), OUM KX4096, bed 3, Foum el Guelta.
- Fig. 7: *Graysonites cherbensis* (Thomas & Peron, 1889), the holotype, MNHP F-R-52077, the original of *Hoplites cherbensis* Thomas & Peron, 1889, p. 31, pl. 17, figs 4, 5, from Bir Mageur, Djebel Cherb, Tunisia.
- Fig. 8: *Graysonites cherbensis* (Peron, 1889), OUM KX4108, bed 3, Foum el Guelta.
- Fig. 9: *Graysonites cherbensis* (Peron, 1889), OUM KX4055 bed 3, Foum el Guelta.
- Figs 10 *Graysonites cherbensis* (Thomas & Peron, 1889), MNHP R52350a, from Djebel Mrhila (see also fig. 2).
- Fig. 11: *Graysonites cherbensis* (Thomas & Peron, 1889), SP unregistered ex Blayac Collection, from Oued Cheniour, Algeria.
- Fig. 12: *Graysonites cherbensis* (Thomas & Peron, 1889), SP unregistered ex Blayac Collection, from Oued Cheniour, Algeria.
- (Figs 1, 2, 7, 10-12: lower bar scale is 10 mm; figs 3-6, 8: upper bar scale is 10 mm)



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Plate X

- Fig. 1: *Sharpeiceras schlueteri* Hyatt, 1903, OUM KX1969, from bed 3, Fom el Guelta.
- Fig. 2: *Sharpeiceras schlueteri* Hyatt, 1903, SP unregistered, ex Pervinquièrè Collection, from Djebel Rebeiba, Central Tunisia, mentioned by Pervinquièrè, 1907, p. 302.
- Fig. 3: *Sharpeiceras laticlavium* (Sharpe, 1855), OUM KX2393, from the base of bed 7, south of Sif et Tella.
- Fig. 4: *Calycoceras* (*Newboldiceras*) cf. *vergonsense* (Collignon, 1937), OUM KX15911, from the lower part of bed 13, Fom el Guelta.
- Fig. 5: *Sharpeiceras schlueteri* Hyatt, 1903, MNHP R52356, from Djebel Mrhila.
- Fig. 6: *Calycoceras* (*Gentoniceras*) cf. *gentoni* (Brongniart, 1822), OUM KX3122, from the base of bed 8, south of Sif et Tella.
- Fig. 7: *Calycoceras* (*Newboldiceras*) cf. *vergonsense* (Collignon, 1937), OUM KX1904, from the lower part of bed 13, Fom el Guelta.
- Fig. 8: *Mantelliceras cantianum* Spath, 1926a, OUM KX1929, from the base of bed 7, Fom el Guelta.
- Fig. 9: *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), OUM KX15910, from bed 13, Fom el Guelta.
- Fig. 10: *Sharpeiceras schlueteri* Hyatt, 1903, OUM KX1196/7, from bed 5, south of Sif et Tella.
- (Bar scale is 10 mm)



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Plate XI

- Fig. 1: *Sharpeiceras schlueteri* Hyatt, 1903, OUM KX1980, from bed 5, Foum el Guelta.
 Fig. 2: *Sharpeiceras schlueteri* Hyatt, 1903, OUM KX1966, from bed 3, Foum el Guelta.
 Fig. 3: *Sharpeiceras florencae* Spath, 1925, OUM KX1070, from bed 5, south of Sif et Tella.
 Fig. 4: *Sharpeiceras mocambiquense* Choffat, 1903, OUM KX 1979, from bed 5, Foum el Guelta.
 (Bar scale is 10 mm)



1a



1b



2



3a



4a



4b



3b

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Plate XII

- Fig. 1: *Acompsoceras renevieri* (Sharpe, 1857), SP unregistered, ex Pervinquièrre Collection, the original of *Acompsoceras essendiensis* var. *madjeurensis* Pervinquièrre, 1907, p. 306, pl. 17, fig. 6, from below Kef Si Abd El Kader.
- Fig. 2: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX2026, from bed 9, Foul el Guelta.
- Fig. 3: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX2001, from bed 9, Foul el Guelta.
- Fig. 4: *Acanthoceras rhotomagense* (Brongniart, 1822), OUM KX3221, from bed 10, south of Sif et Tella.
- Fig. 5: *Acompsoceras inconstans* (Schlüter, 1871), SP unregistered, ex Pervinquièrre Collection, the original of *Acompsoceras sarthensis* of Pervinquièrre, 1907, p. 303, pl. 17, fig. 3, from below Kef Si Abd El Kader.
- Fig. 6: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX3158, from bed 8, south of Sif et Tella.
- Fig. 7: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX3282 from bed 8, south of Sif et Tella.
- (Bar scale is 10 mm)



1a



1b



2a



3a



3b



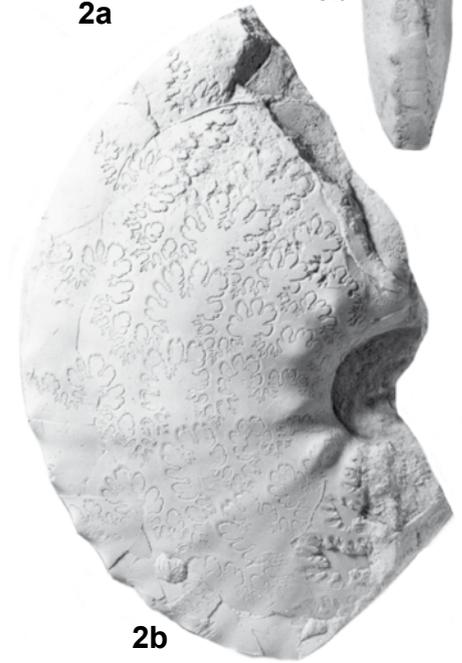
4



5a



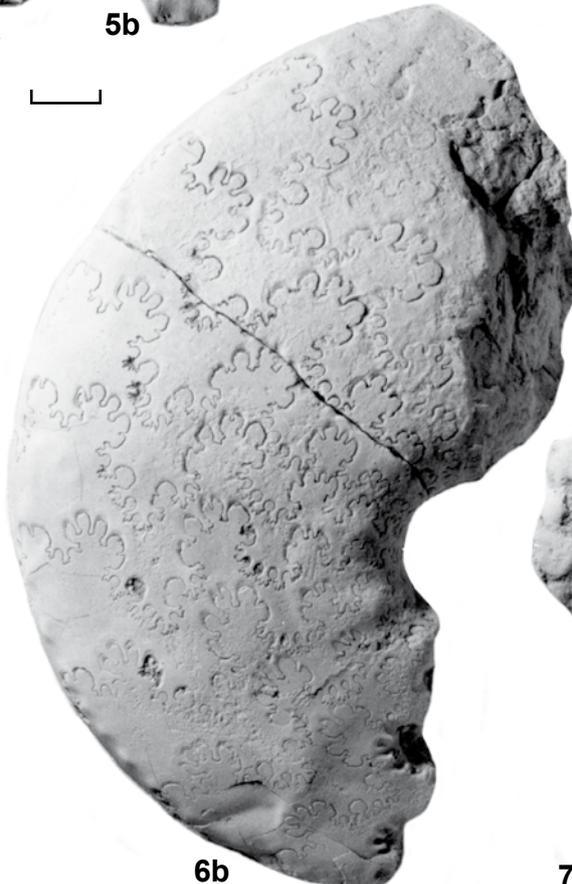
5b



2b



6a



6b



7a

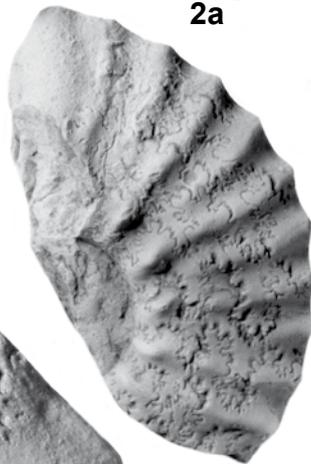


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Plate XIII

- Fig. 1: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX3160, from bed 8, south of Sif et Tella.
- Fig. 2: *Acompsoceras inconstans* (Schlüter, 1871), SP unregistered, ex Pervinquier Collection, the original of Pervinquier, 1907, pl. 17, fig. 2, from below Kef Si Abd El Kader.
- Fig. 3: *Acompsoceras inconstans* (Schlüter, 1871), OUM KX1953, from bed 8, Fom el Guelta.
- Fig. 4: *Acompsoceras renevieri* (Sharpe, 1857), SP unregistered, ex Pervinquier Collection, the original of Pervinquier, 1907, pl. 17, fig. 1, from below Kef Si Abd El Kader.
- Fig. 5: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX1399/1401, from bed 8, south of Sif et Tella. (Bar scale is 10 mm)



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 Plate XIV

- Fig. 1: *Cunningtoniceras* sp. juv., OUM KX3180, from bed 8, south of Sif et Tella.
- Fig. 2: *Calycoceras* (*Proeucalycoceras*) *haugi* (Pervinquièrre 1907), OUM KX1898, from the lower part of bed 13, Foum el Guelta.
- Fig. 3: *Cunningtoniceras* sp. juv., OUM KX3170, from bed 8, south of Sif et Tella.
- Fig. 4: *Cunningtoniceras inerme* (Pervinquièrre, 1907), OUM KX15907, from bed 9, Foum el Guelta.
- Fig. 5: *Acanthoceras rhotomagense* (Brongniart, 1822), OUM KX3220, from bed 10, south of Sif et Tella.
- Fig. 6: *Acanthoceras rhotomagense* (Brongniart, 1822), OUM KX1911, from the lower part of bed 13, Foum el Guelta.
- Fig. 7: *Acompsoceras renevieri* (Sharpe, 1857), OUM KX 3285, from bed 8, south of Sif et Tella.
- (Bar scale is 10 mm)



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2b



3a



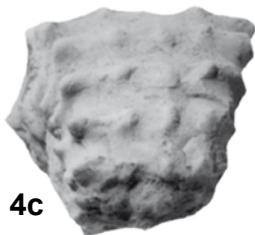
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4c



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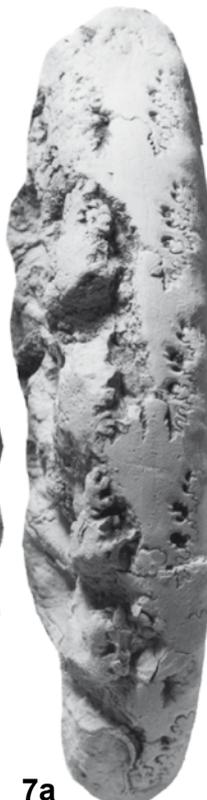
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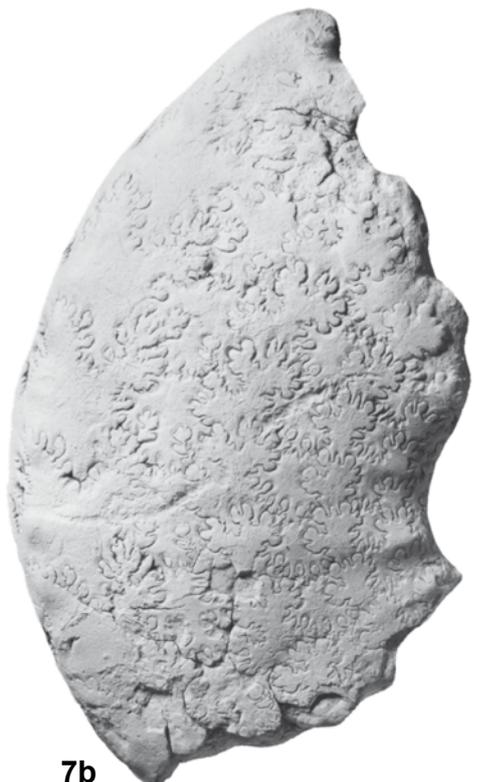
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Plate XV

- Fig. 1: *Cunningtoniceras inerme* (Pervinquierè, 1907), OUM KX3204, from bed 10, south of Sif et Tella
Fig. 2: *Cunningtoniceras africanum* (Pervinquierè 1907), OUM KX3169, from bed 8, south of Sif et Tella.
Fig. 3: *Cunningtoniceras meridionale* (Stoliczka, 1864), SP unregistered, ex Flick Collection, the original of *Acanthoceras meridionale* var. *tuberculata* of Pervinquierè, 1907, p. 280, pl. 15, fig. 6, from Foum el Guelta.
Fig. 4: *Cunningtoniceras africanum* (Pervinquierè, 1907), OUM KX2033, from bed 9, Foum el Guelta.
Fig. 5: *Cunningtoniceras africanum* (Pervinquierè, 1907), the lectotype, SP unregistered, ex Flick Collection, the original of Pervinquierè, 1907, pl. 15, fig. 3 from Kef Si Abd El Kader.
Fig. 6: *Cunningtoniceras africanum* (Pervinquierè, 1907), paralectotype, SP unregistered, ex Flick Collection, the original of Pervinquierè, 1907, pl. 15, fig. 4 from Foum el Guelta.
(Bar scale is 10 mm)



4b

6a

6b



Plate XVI

- Fig. 1: *Cunningtoniceras meridionale* (Stoliczka, 1864), SP unregistered, ex Flick Collection, the original of *Acanthoceras meridionale* var. *tuberculata* Pervinquier, 1907, p. 280, pl. 15, fig. 5, from Djebel Sidi bou Goubrine.
- Fig. 2: *Lotzeites elegans* sp. nov., OUM KX1910, from bed 13, Fom el Guelta.
- Fig. 3: *Lotzeites elegans* sp. nov., the holotype, and a paralectotype of *Cunningtoniceras africanum* (Pervinquier, 1907), SP unregistered ex Flick Collection, the original of Pervinquier 1907, p. 280, pl. 15, fig. 2, from Fom el Guelta.
- Fig. 4: *Cunningtoniceras africanum* (Pervinquier, 1907), OUM KX3209, from bed 10, south of Sif et Tella.
- Fig. 5: *Cunningtoniceras meridionale* (Stoliczka, 1864), OUM KX1385, from bed 8, south of Sif et Tella.
- Fig. 6: *Cunningtoniceras africanum* (Pervinquier, 1907), OUM KX3214, from bed 10, south of Sif et Tella.
- Fig. 7: *Cunningtoniceras africanum* (Pervinquier, 1907), OUM KX3207, from bed 10, south of Sif et Tella.
- Fig. 8: *Acanthoceras rhotomagense* (Brongniart, 1822), OUM KX3219, from bed 10, south of Sif et Tella.
- Fig. 9: *Acanthoceras rhotomagense* (Brongniart, 1822), OUM KX3223, from bed 10, south of Sif et Tella.
- (Bar scale is 10 mm)

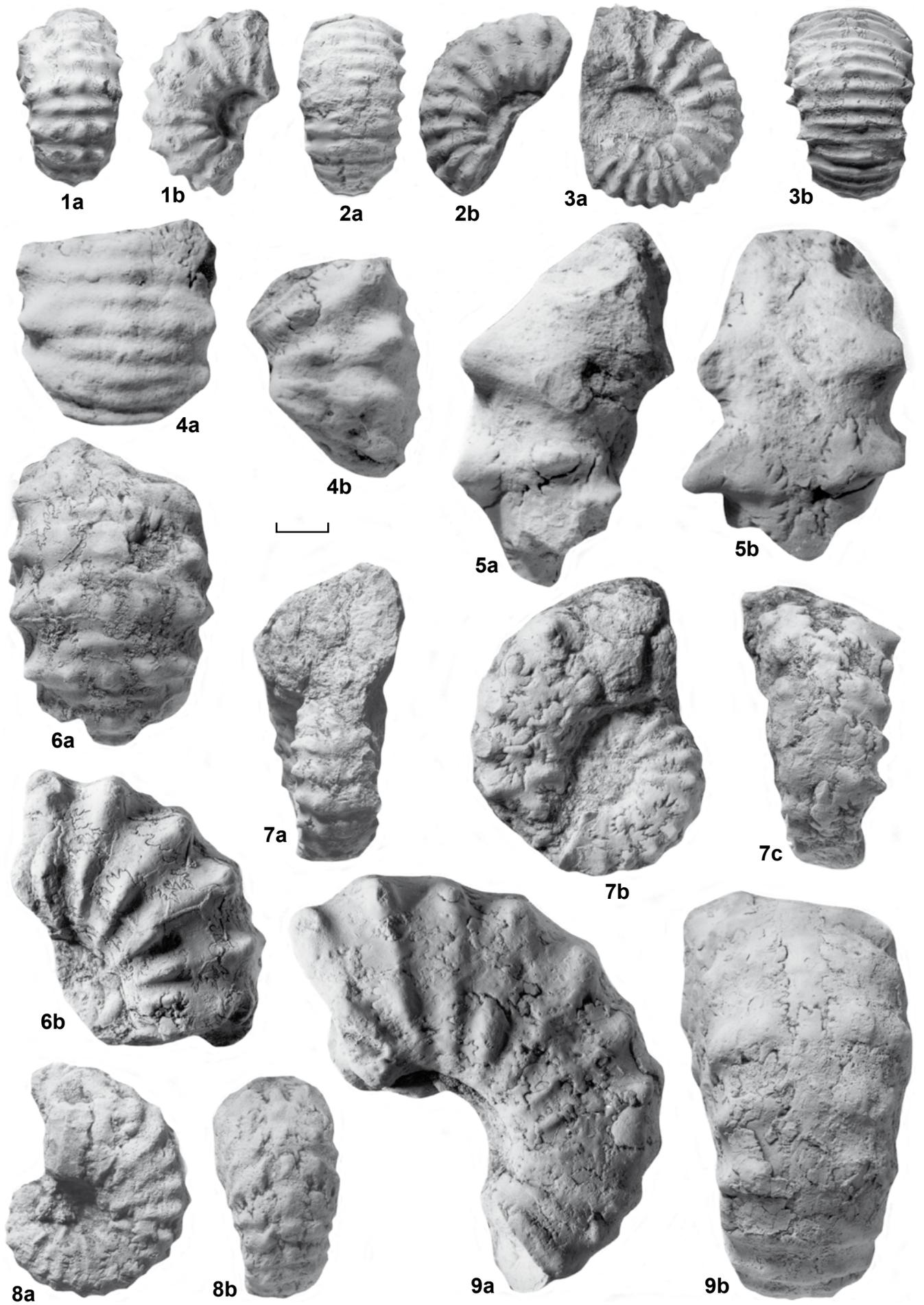


Plate XVII

- Fig. 1: *Cunningtoniceras inerme* (Pervinquière, 1907), OUM KX3205, from bed 10, south of Sif et Tella.
Fig. 2: *Cunningtoniceras africanum* (Pervinquière, 1907), OUM KX3211, from bed 10, south of Sif et Tella.
Fig. 3: *Cunningtoniceras?* sp., OUM KX3199, from bed 10, Foum el Guelta.
Fig. 4: *Cunningtoniceras?* sp., OUM KX3198, from bed 10, Foum el Guelta.
(Bar scale is 10 mm)



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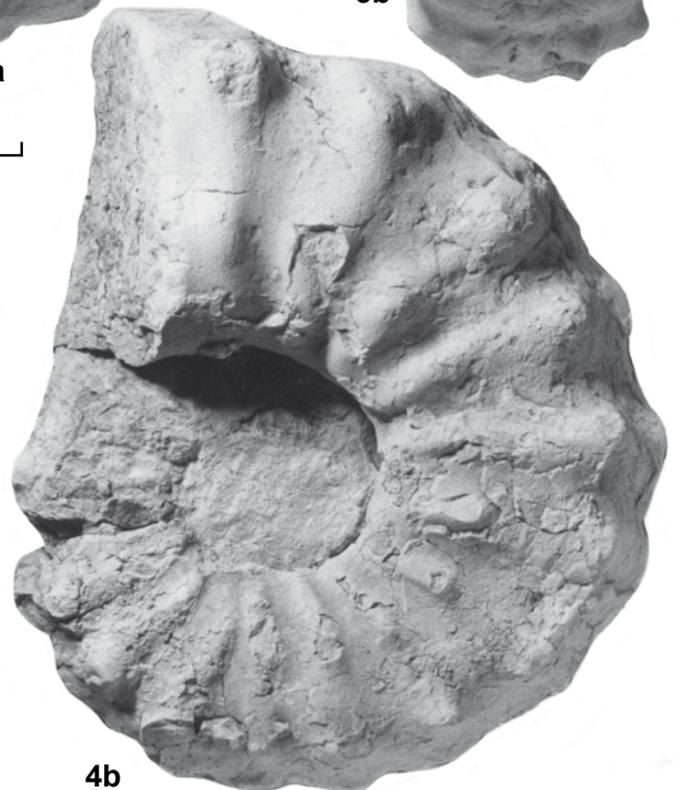
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4b

Plate XVIII

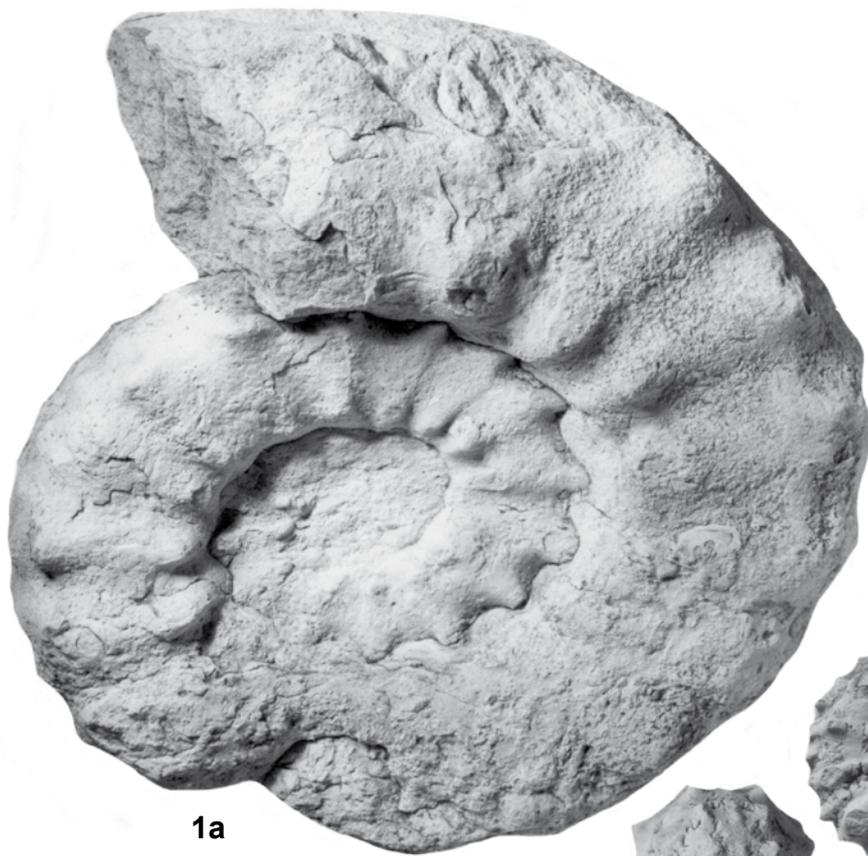
Fig. 1: *Cunningtoniceras tinrhertense* (Collignon, 1965), OUM KX1989, from bed 17, Foum el Guelta.

Fig. 2: *Cunningtoniceras tinrhertense* (Collignon, 1965), OUM KX1875, from the base of bed 19, Foum el Guelta.

Fig. 3: *Cunningtoniceras tinrhertense* (Collignon, 1965), OUM KX1874, from the base of bed 19, Foum el Guelta.

Fig. 4: *Thomelites sornayi* (Thomel, 1966), OUM KX1994, from the base of bed 14, Foum el Guelta.

(Bar scale is 10 mm)



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3b



4b



2a



2b

Plate XIX

- Fig. 1: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1893, from the lower part of bed 13, Foum el Guelta.
Fig. 2: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1894, from the lower part of bed 13, Foum el Guelta.
Fig. 3: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1899, from the lower part of bed 13, Foum el Guelta.
Fig. 4: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1986, from bed 17, Foum el Guelta.
Fig. 5: *Pseudocalycoceras haugi* (Pervinquière, 1907), a syntype, copy of Pervinquière, 1907, pl. 14, fig. 1; the original was from Kef Si Abd El Kader.
Fig. 6: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1896, from the lower part of bed 13, Foum el Guelta.
(Bar scale is 10 mm)

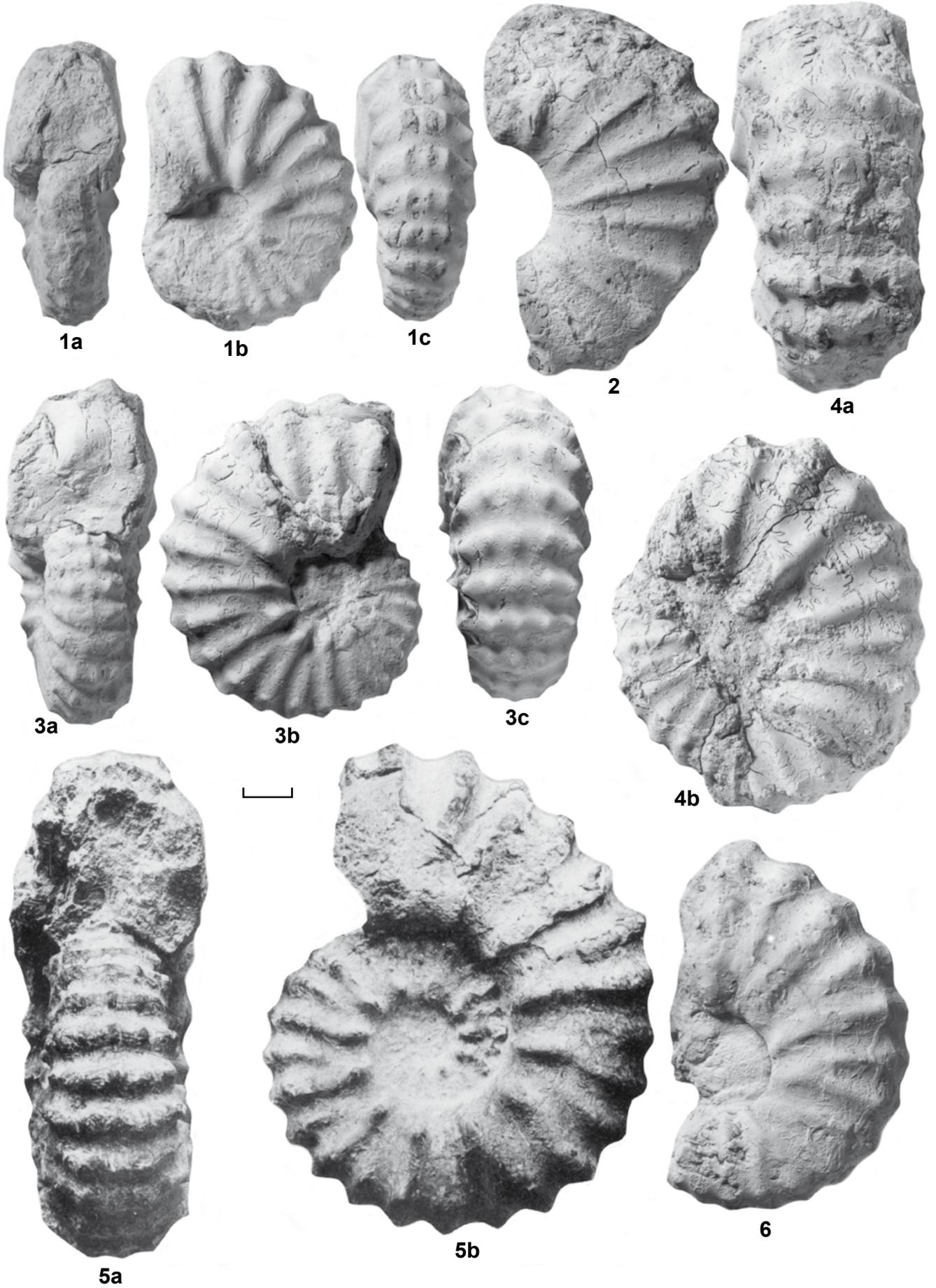


Plate XX

- Fig. 1: *Cunningtoniceras inerme* (Pervinquière, 1907), OUM KX3208, from bed 10, south of Sif et Tella.
- Fig. 2: *Calycoceras* (*Proeucalycoceras*) *haugi* (Pervinquière, 1907), SP unregistered, *ex* Pervinquière Collection, a syntype fragment (mentioned by Pervinquière, 1907, p. 271), from Foum el Guelta.
- Fig. 3: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1891, from the lower part of bed 13, Foum el Guelta.
- Fig. 4: *Pseudocalycoceras jullieni* (Collignon, 1937), OUM KX1991, collected loose, but derived from beds 14-17, Foum el Guelta.
- Fig. 5: *Calycoceras* (*Proeucalycoceras*) *haugi* (Pervinquière, 1907), OUM KX1895, from the lower part of bed 13, Foum el Guelta.
- Fig. 6: *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), OUM KX1996, from the base of bed 14, Foum el Guelta.
- Fig. 7: *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), OUM KX1895, from the base of bed 14, Foum el Guelta.
- Fig. 8: *Calycoceras* (*Newboldiceras*) *asiaticum asiaticum* (Jimbo, 1894), OUM KX3226, from bed 10, south of Sif et Tella.
- Fig. 9: *Calycoceras* (*Gentoniceras*) *boehmi* (Spath, 1926b), OUM KX1901, from the lower part of bed 13, Foum el Guelta.
- (Bar scale is 10 mm)

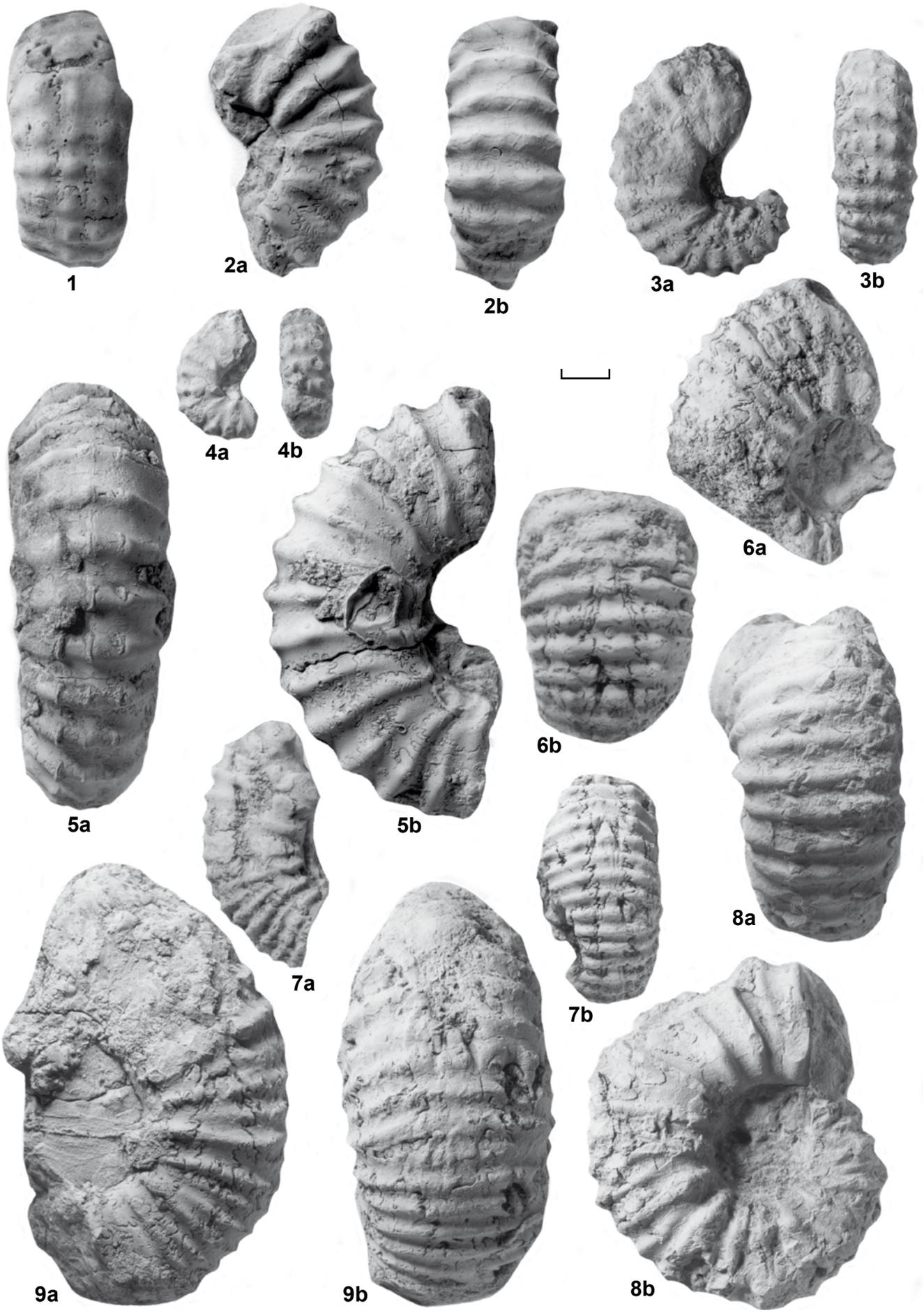


Plate XXI

- Fig. 1: *Eucalycoceras pentagonum* (Jukes-Browne, 1896), SP unregistered, ex Flick Collection, mentioned by Pervinquière, 1907, p. 271, from Foum el Guelta.
- Fig. 2: *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897), OUM KX1908, from bed 13, Foum el Guelta.
- Fig. 3: *Pseudocalycoceras judaicum* (Taubenhaus, 1920), OUM KX1890, from the lower part of bed 13, Foum el Guelta.
- Fig. 4: *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897), OUM KX1902, from bed 13, Foum el Guelta.
- Fig. 5: *Calycoceras (Newboldiceras) tunisiense* sp. nov., SP unregistered, ex Pervinquière Collection, the original of *Acanthoceras jimboi* var. *tunetana* Pervinquière, 1907, p. 263, pl. 14, fig. 2, from Kef Si Abd El Kader.
- Fig. 6: *Eucalycoceras batnense* (Collignon, 1937), OUM KX1443, from the middle part of bed 13, south of Sif et Tella.
(Bar scale is 10 mm)



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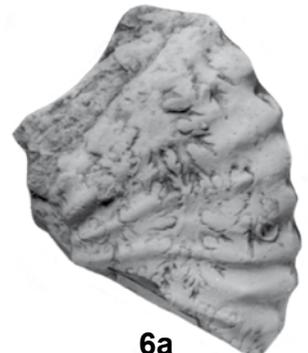
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Plate XXII

- Fig. 1: *Calycoceras* (*Gentoniceras*) cf. *gentoni* (Brongniart, 1822), OUM KX3237, from south of Sif et Tella.
Fig. 2: *Acompsoceras* sp. juv.?, OUM KX3173, from bed 8, south of Sif et Tella.
Fig. 3: *Pseudocalyoceras jullieni* (Collignon, 1937), OUM KX1889, from the lower part of bed 13, Foum el Guelta.
Fig. 4: *Calycoceras* (*Newboldiceras*) sp., OUM KX3225, from bed 10, south of Sif et Tella.
Fig. 5: *Pseudocalyoceras jullieni* (Collignon, 1937), OUM KX1892, from the lower part of bed 13, Foum el Guelta.
Fig. 6: *Calycoceras* (*Calycoceras*) *naviculare* (Mantell, 1822), OUM KX1870, from the base of bed 19, Foum el Guelta.
Fig. 7: *Calycoceras* (*Gentoniceras*) cf. *lafouxense* Thomel, 1972, OUM KX1992, collected loose, but from beds 14-17, Foum el Guelta.
Fig. 8: *Cunningtoniceras tinrhertense* (Collignon, 1965), OUM KX1988, from bed 17, Foum el Guelta.
Fig. 9: *Eucalycoceras palaestinense* (Blanckenhorn, 1890), OUM KX1896, from the lower part of bed 13, Foum el Guelta.
(Bar scale is 10 mm)



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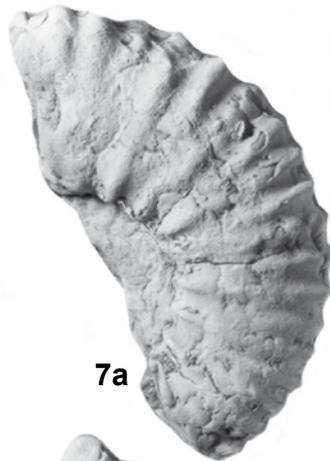
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Plate XXIII

- Fig. 1: *Calycoceras (Newboldiceras) asiaticum spinosum* (Kossmat, 1897), SP unregistered, ex Pervinquière Collection, the original of Pervinquière, 1907, pl. 13, fig. 3, from Kef Si Abd El Kader.
- Fig. 2: *Mantelliceras lymese* (Spath, 1926b), SP unregistered, ex Flick Collection, from Foum el Guelta.
- Fig. 3: *Calycoceras (Newboldiceras) asiaticum asiaticum* (Jimbo, 1894), SP unregistered, ex Aubert Collection, the original of Pervinquière, 1907, pl. 13, fig. 1, from Ain el Glaa, Djebel Bireno.
- (Bar scale is 10 mm)



1a



1b



1c



1d



2a



2b



2c



3a



3b



3c

 Plate XXIV

- Figs 1, 2: *Mariella (Mariella) cf. oehlerti* (Pervinquière, 1910), OUM KX1201, from the lower part of bed 3, south of Sif et Tella.
- Fig. 3: *Mariella (Mariella) cf. oehlerti* (Pervinquière, 1910), OUM KX4112, from bed 3, Foum el Guelta.
- Fig. 4: *Algerites cf. ellipticus* (Mantell, 1822), OUM KX1200, from the lower part bed 3, Foum el Guelta.
- Fig. 5: *Turrilites costatus* Lamarck, 1801, OUM KX 3241/2, from bed 10, south of Sif et Tella.
- Fig. 6: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX2015, from bed 9 (?), Foum el Guelta.
- Fig. 7: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX3140, from bed 8, south of Sif et Tella.
- Fig. 8: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX2013, from bed 9 (?), Foum el Guelta.
- Fig. 9: *Turrilites costatus* Lamarck, 1801, OUM KX 3241/1, from bed 10, south of Sif et Tella.
- Fig. 10: *Neostlingoceras carcitanense* (Matheron, 1842), SP unregistered, ex Pervinquière Collection, the original of Pervinquière, 1907, pl. 4, fig. 17, from Djebel Mrhila, labelled 'Marnes Inférieurs Cen.'
- Fig. 11: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX1947, collected loose, Foum el Guelta.
- Fig. 12: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX2040, from bed 9, Foum el Guelta.
- Fig. 13: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX2013, from bed 8, Sif et Tella.
- Fig. 14: *Mariella (Mariella) bergeri* (Brongniart, 1822), OUM KX815, from south of Foum el Guelta.
- Fig. 15: *Mariella (Mariella) aff. dorsetensis* Spath 1926b, OUM KX2412, from the base of bed 7 of the Sif et Tella section.
- Fig. 16: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX2014, from bed 9 (?), Foum el Guelta.
- Fig. 17: *Mariella (Mariella) bergeri* (Brongniart, 1822), OUM KX8154, from south of Foum el Guelta.
- Fig. 18: *Hypoturrilites laevigatus* (Coquand, 1862), OUM KX2036, from bed 9, Foum el Guelta.
- Fig. 19: *Turrilites scheuchzerianus* Bosc, 1801, OUM KX1948, collected loose, Foum el Guelta.
- (Bar scale is 10 mm.)

