

Ammonite faunas from condensed Cenomanian-Turonian sections ('Tourtias') in southern Belgium and northern France*

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Abstract

In southern Belgium (Mons Basin and Tournai region) and northern France (area between Lille, Valenciennes and Maubeuge), condensed sequences have been referred to as 'tourtias' since the start of the nineteenth century. These levels correspond to a succession of transgressive systems tracts and generally appear as dark green, glauconitic and microconglomeratic facies. They are distributed all along the base of the more important transgressive systems tracts of the Cenomanian and basal Turonian from the Boulonnais (northwest France) to the Mons Basin (southern Belgium), through the Artois and Douaisis. Their age can now be determined more accurately by identification of their ammonite content, as housed in museums such as the Institut royal des Sciences naturelles de Belgique (IRScNB, Brussels) and the Musée d'Histoire naturelle de Lille (MHNL). Here material from the IRScNB collections is described, illustrated and discussed; specimens contained in the MHNL collections were described in a previous paper.

Keywords: Ammonoidea, Cenomanian, Turonian, tourtia, condensed sequences, Belgium, France, correlation

Introduction

It has long been known that condensed sequences, commonly known as 'tourtias', in the lower Upper Cretaceous of southern Belgium and northern France yield distinctive ammonite faunas that can be used to date these sections and provide correlations with sections elsewhere in Europe and further afield (Robaszynski et al., 2002). Originally, at the start of the nineteenth century, the term 'tourtia' was used by miners to refer to greenish, granular rocks encountered between the overburden and the coal-producing levels. The origin of the word is related to the resemblance of this rock type to the residues left after the production of colza oil, 'tourteau-tourtia-tourtia' (Drapiez, 1823; d'Archiac, 1847). Later, during the construction of numerous collieries in the Walloon part of Belgium and in northern France, a 'tourtia' represented a conglomeratic or

microconglomeratic rock, formed of pebbles or of pieces of rock of pre-Cenomanian or Cenomanian age in a chalky or marly matrix, occasionally sandy and ferruginous. Most often the rock is glauconitic and of a dark green colour.

Based on studies by Dumont (1849), F.L. Cornet & Briart (1866), Barrois (1878), Gosselet (1881, 1904-1914), Cayeux (1889) and Marlière (1936, 1939a-c), it became apparent that there were various successive levels of tourtias, of different ages. Marlière (1957), Polvêche (1957) and Robaszynski (1980b) summarised data in various entries in the 'Lexiques'. The various tourtias encountered in quarries and penetrated in mine shafts have yielded numerous fossils, part of which are now housed in collections such as the ones at the Musée d'Histoire naturelle de Lille (MHNL) and the Institut royal des Sciences naturelles de Bruxelles (IRScNB).

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The ammonites in the IRScNB collections originate from tourtias in the Tournai area, the Mons Basin and from between Maubeuge and Valenciennes (Fig. 1). A revision of these faunas was initiated by two of us, WJK and JWMJ; independently, and unaware of this revision, FA and FR had been studying tourtia ammonites in the MNHL collections in recent years. Those specimens originate from the Boulonnais, Artois, the environs of Douai, Valenciennes, Maubeuge and Tournai, as well as from the Mons Basin. For illustrations of the most important species and a sequence-stratigraphic interpretation of the tourtias, reference is here made to Amédéo & Robaszynski (2010). The present paper assembles data from both studies; of note is that the IRScNB material comprises a number of novelties, such as Early Cenomanian ammonite taxa from Tournai, Onnaing, Hautrage and Bettrechies, not documented by Amédéo & Robaszynski (2010).

Tourtia successions

Bettrechies quarry, northern France

Detailed sampling at the disused SECAB quarry (Robaszynski, 1980a) has demonstrated a succession of various units (thickness: a dozen metres) overlying limestones of Givetian (late Middle Devonian) age which were exploited here (compare Fig. 7). From bottom to top (the fossil taxa listed are based on MNHL collections or personal observation) these are:

- *Wealden facies* – black clays with fragments of pyritised fossil wood, preserved on a palaeokarstic surface of the Givetian limestone (karst up to several metres in depth);
- ‘*Sarrasin*’ – 1 to 5 metres in thickness (as based on the section logged at the quarry); in those places where this facies is 5 m thick, several levels can be distinguished. At the base

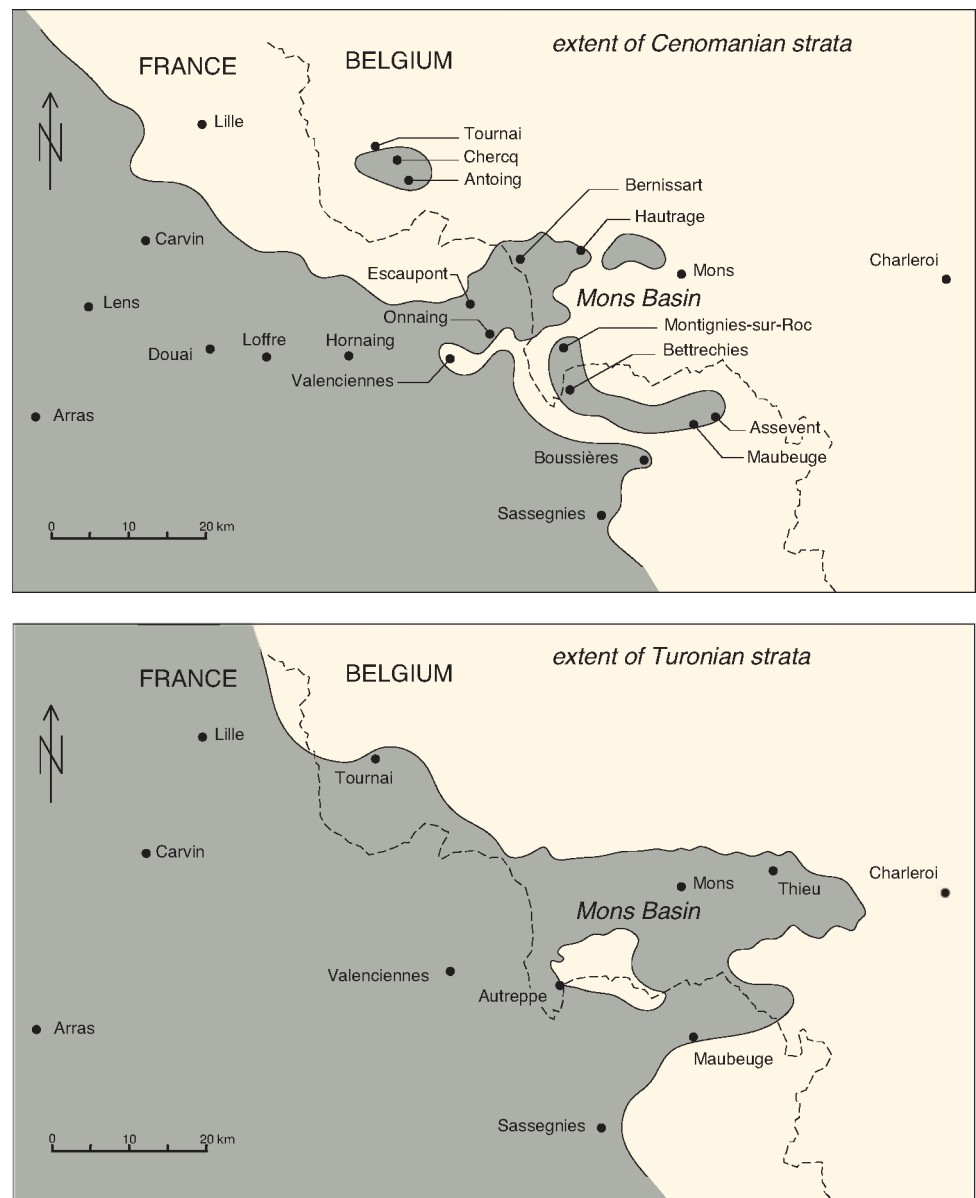


Fig. 1. Locality map and present-day extent of Cenomanian (upper figure) and Turonian (lower figure) formations in southern Belgium and northern France (Mons Basin; area between Tournai and Maubeuge).

occur phosphatic gravels, with overlying these two metres of very coarse-grained, glauconitic calcirudites, with decimetre-sized boulders of Palaeozoic rocks and large-sized oysters forming a kind of conglomerate. An equivalent facies at Montignies-sur-Roc in southern Belgium (Fig. 1) has yielded *Mantelliceras mantelli*, probably from the *Mantelliceras dixoni* Zone (upper Lower Cenomanian). Overlying are two metres of glauconitic calcarenite which, together with the calcirudites, forms what is referred to as ‘crumbly Sarrasin’ (Fig. 7). This is capped by a complex hardground, c. 1 metre thick, constituting the really compact facies, the ‘Sarrasin’ proper. This hardground has yielded *Cunningtonceras inerme*, *Sciponoceras baculoides* and *Schloenbachia coupei*, an association typical of the *Acanthoceras rhotomagense* Zone (lower Middle Cenomanian). The ‘crumbly Sarrasin’ and the Sarrasin proper constitute a lateral chronostratigraphic equivalent of the Tourtia de Tournai, as demonstrated below.

- *Tourtia de Mons* – On top of the Sarrasin hardground surface, which is perforated by lithophagid bivalves and covered in glauconite, follow three metres of variegated layers of a generally grey-bluish marly lithology. At the base, there is a horizon of black and phosphatic pebbles, which has produced fragments of *Calycoceras* cf. *asiaticum*, *C.* cf. *picteti* and *Acanthoceras jukesbrownei* (Fig. 7). Resting on the black gravels are 1.5 metres of glauconitic, bluish marls containing a level of cobbles and capped by a ill-defined hardground with *A. jukesbrownei*. The fossil content of the first subunit belongs to the *A. jukesbrownei* Zone (upper Middle Cenomanian). Overlying this is one metre of bluish marl with a thin hardground. Despite the fact that this level, which is capped by a perforated surface, does not contain any significant macrofauna, it may be assumed that the *Calycoceras guerangeri* Zone was originally present, of early Late Cenomanian age. In fact, this zone has been documented within the glauconitic chalk of the ‘Tourtia de Mons’ at Condé-sur-l’Escaut, at the entry to the Mons Basin, 5 kilometres northeast of Escaupont (Amédro & Robaszynski, 2010, pl. 3, fig. 1). Filling the perforations is a darkish clayey marl (0.2-0.4 m in thickness), with *Praeactinocamax plenus*, *Metoicoceras geslinianum* and planktonic foraminifera such as *Whiteinella archaeocretacea* and *Rotalipora cushmani*, an association which defines the *Metoicoceras geslinianum* Zone (uppermost Cenomanian). It is these three metres of variegated layers which constitute the ‘Tourtia de Mons’, of latest Middle to Late Cenomanian age.
- *Tourtia de Bettrechies* – Another level with black, phosphatic pebbles appears above the ‘plenus Marls’; it is this which has been referred to as the ‘Tourtia de Bettrechies’. Overlying it are several metres of ‘Dièves’ or greyish marls which, when altered, turn beige in colour, and yield *Inoceramus* gr. *labiatus*. Sieve residues have furnished a microfauna with planktonic foraminifera of Early Turonian age, such as *Helvetoglobotruncana helvetica*, *Marginotruncana pseudolinneiana* and *Dicarinella*

hagni. Higher up appears also the small brachiopod *Terebratulina rigida*, which documents the onset of the Middle Turonian.

Abandoned quarries in the Tournai area

South of Tournai (Figs 1, 3), the Cretaceous cover in quarries where Carboniferous limestones were exploited, has been the subject of numerous studies since the beginning of the nineteenth century. Based on collections made by Charles Lèveillé (donated by him in 1839 to the Société géologique de France), d’Archiac (1846) undertook to identify all specimens originating from the ‘Tourtia de Tournai’. In his ‘Rapport sur les fossiles du Tourtia’ (d’Archiac, 1847), the list of species comprises numerous bivalves, gastropods, brachiopods (a plethora of terebratulids, i.e., 48 species, 37 of which were new), corals, echinoderms and more, yet but a single cephalopod, *Ammonites varians* Sow., which was not described nor illustrated. According to d’Archiac, this ‘Tourtia de Tournai’ had been laid down ‘after the Gault period’ (which would later become the Cenomanian) and he well noted (p. 346) the presence of ‘*Belemnites canaliculatus* (var ? *actinocamax*) qui existait parmi les fossiles de Tournai (et) ne nous a point paru provenir de cette localité’. This means that he had certainly realised the possibility that another, younger tourtia existed, but at another locality. It was Cayeux (1889), who described and understood the superposition of several tourtias in his ‘Crétacé de Chercq près Tournai’. Barrois (1878, p. 374) had recorded a similar succession at Bellignies, a locality which corresponds to Bettrechies here, as had F.L. Cornet & Briart (1866, p. 85) in Hainaut.

Today, the ideal and complete lithological succession is as follows, from bottom to top:

- *Wealden facies* – On Palaeozoic (Visean, middle Mississippian) black limestones, inclined and peneplained, clays and sands of Wealden type are occasionally preserved in palaeokarst (e.g., at Bettrechies).
- *Tourtia de Tournai* – This is the ‘first’ tourtia, which rests unconformably on the Palaeozoic basement. It is a compact conglomerate with large-sized cobbles and boulders of Palaeozoic rock, in a brown calcareous and ferruginous cement. Its thickness may vary from several decimetres to 1 to 1.5 metres. This is a condensed level, rich in fossils, details of which have first been presented and illustrated by d’Archiac (1847), who noted in particular the ammonite *Schloenbachia varians*, the echinoid *Codiopsis doma* and several brachiopods, such as *Terebratula nerviensis*, *T. tornacensis* and ‘*Terebratula*’ (= *Orbirhynchia*) *mantelliana*, illustrating its Early to Middle Cenomanian age.
- *Tourtia de Mons* – Above, the ‘second’ tourtia has a very different habit; this is a bed of between 2 and 20-30 centimetres in thickness, comprising marls, or ‘Dièves’, which contain centimetre-sized gravels of black phtanite and milky

quartz, as well as brown phosphatic pebbles in a greenish marly to sandy, glauconitic matrix. At the disused Delwart quarry (Figs 3-5), this tourtia has yielded *Praeactinocamax plenus*, remanié elements of the underlying Tourtia de Tournai and even fossils reworked from the Carboniferous limestone basement. At the Bettrechies quarry, this level has been shown to contain planktonic foraminifera, in particular *Rotalipora cushmani*. Macro- and microfossil taxa are indicative of a Late Cenomanian age.

- *Tourtia de Bettrechies* – In some places, e.g., at Bettrechies, occasionally there is above the ‘plenus Marls’ a thin level of black pebbles, which testifies to a ‘third’ tourtia at the very base of several metres of yellowish ‘Dièves’ which produced *Mammites nodosoides*, *Inoceramus labiatus*, *Orbirhynchia cuvieri* and planktonic foraminifera such as *Marginotruncana hagni* and *Helvetoglobotruncana helvetica*, an association which dates this third tourtia as Early Turonian. However, it should be noted that very often the Tourtia de Mons and Tourtia de Bettrechies are not visibly differentiated, the whole being condensed and with an admixture of black pebbles and remanié Palaeozoic fossils, sometimes reworked cobbles from the Tourtia de Tournai, abraded fragments of *P. plenus*, *O. cuvieri* and *I. labiatus*, very rarely *M. nodosoides*, all in a chalky marl with glauconite grains. Having been dated as Early Turonian, this is the equivalent of the Tourtia de Bettrechies proper.
- *Cenozoic silty clays* – Above several metres of ‘Dièves’ follows a discontinuity surface occasionally marked by a basal gravel, above which follow clayey siltites of Thanetian (late Paleocene) age.

Age of the ammonite assemblages

All localities from which the specimens here revised originate are shown in Fig. 1, which also illustrates the current extent of Cenomanian and Turonian strata in the area. In Fig. 2, all lithological symbols used in Figs 4-7 are explained, while Fig. 3 shows the disused Delwart and du Cornet quarries, south of Tournai. Logs of the Delwart and du Cornet quarries are
















	marly chalk		pebbles and cobbles
	marl		glauconite
	clay		phosphatic nodules
	nodular limestone		Carboniferous limestone
	glauconitic siltstone		ammonite
	sandstone		<i>Praeactinocamax</i>
	hardground		<i>Entolium</i>
	burrowed surface		

Fig. 2. Key to symbols used in Figs 5-7.

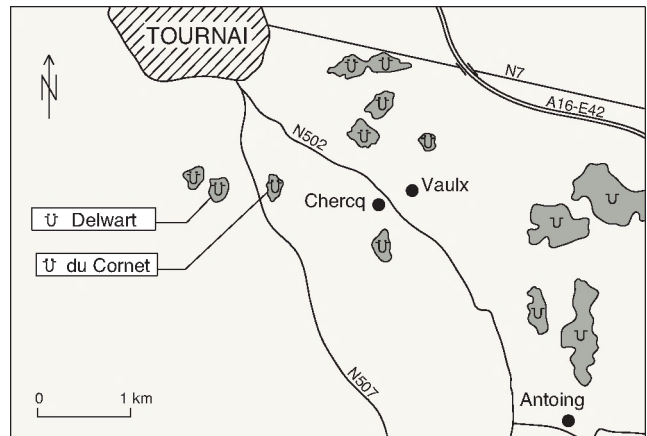


Fig. 3. Locality map of the two old quarries Delwart and du Cornet.

shown in Figs 4 and 5, illustrating the stratigraphic range and correlation of the Tourtia de Tournai, while Fig. 8 illustrates the development of sequences and systems tracts in northern France and southern Belgium, highlighting the position of the various tourtias.

Tourtia de Tournai (Tournai, Hainaut, southern Belgium) – Internal moulds are brown, limonite coated, or retain limonitised shell material, and are of a buff granular limestone with scattered grains of glauconite, quartz and limonite. Preserved in this way are *Schloenbachia varians*, *Sch. coupei* (and passage forms from *varians*), *Hamites simplex*, *Mesoturrilites corrugatus*, *Turrilites acutus*, *Sciponoceras baculoides*, *Sci. roto* and *Scaphites obliquus*. *Schloenbachia varians*, *Sci. roto* and *M. corrugatus* indicate the Lower Cenomanian *Mantelliceras mantelli* to *Mantelliceras dixoni* zones; *Turrilites acutus* and other species the upper, *Turrilites acutus* Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone.

Occurring as creamy-buff internal moulds, some with replaced shell of the same colour, predominantly preserved as micritic limestone with glauconite, quartz and limonite grains are *Schloenbachia varians*, *Sch. coupei*, *Acanthoceras rhotomagense* and *Sci. baculoides*. Possibly, these indicate horizons from the lower Lower Cenomanian *Mantelliceras mantelli* Zone to the lower, *Turrilites costatus* Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone. However, it is more likely that the range was uppermost Lower Cenomanian (*Mantelliceras dixoni* Zone) to the *Turrilites costatus* Subzone.

Labelled as coming from the ‘Tourtia de Tournai’ are dark brown to black phosphatic internal moulds of *Lewesiceras* sp. juv., resembling *L. cenomanense* Wiedmann & Schneider, 1979 of late Late Cenomanian *Metoicoceras geslinianum* Zone age, or possibly even younger (compare Kaplan et al., 1998). Here, we consider these specimens to have been mislabelled; they may have originated from the Tourtia de Mons, of latest Cenomanian age. Similarly, a single specimen of *Mammites nodosoides*, of a comparable preservation and labelled ‘Tourtia de Tournai’, more probably came from the Tourtia de Bettrechies or from the ‘Dièves’ proper, of Early Turonian age (see Fig. 5).

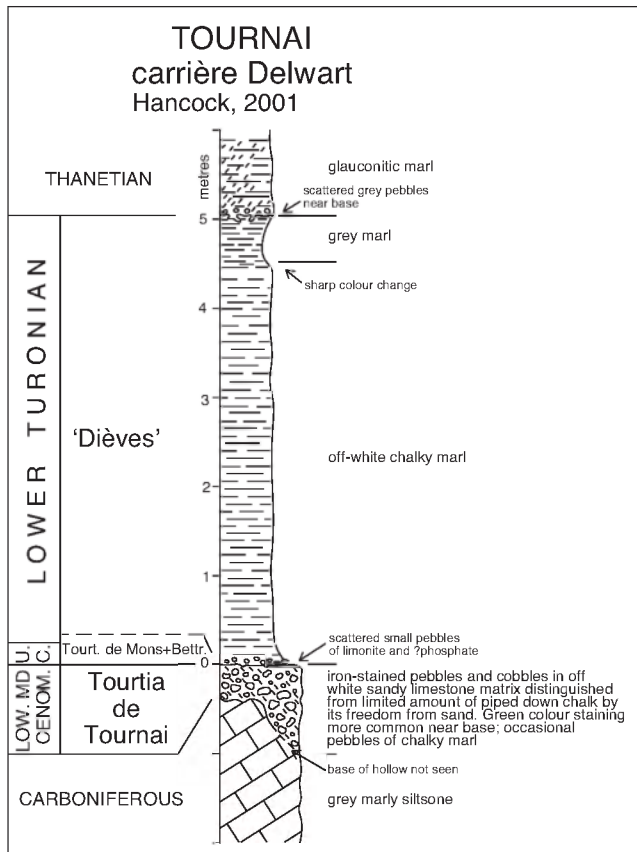
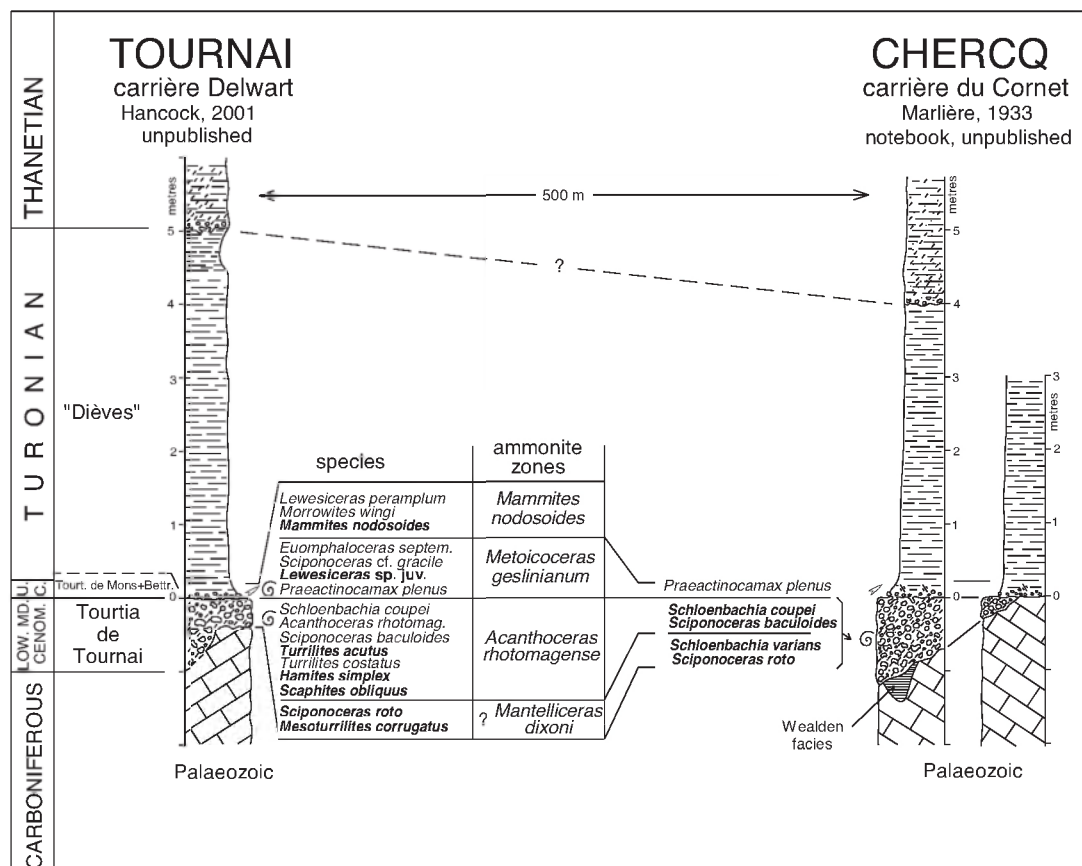


Fig. 4. Section of Delwart old quarry, 2 km south/southeast of Tournai (after fieldnotes by Hancock, 2001).

Tourtia de Tournai (Chercq, Hainaut, southern Belgium) – The ammonites from this locality are predominantly preserved as creamy-buff internal moulds in micritic limestone with scattered quartz, glauconite and limonite grains, some with a light limonitic coating, one with patches of limonitised shell. The assemblage is: *Schloenbachia varians*, *Sch. coupei*, *Sci. baculoides*, *Sci. roto* and *Scaphites* sp. An interval from the Lower Cenomanian *Mantelliceras mantelli* Zone (i.e., *Sch. varians* and *Sci. roto*) to the lower, *Turrilites costatus* Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone (i.e., *Sch. coupei* and *Sci. baculoides*) is indicated.

Tourtia de Montignies-sur-Roc (Hainaut, southern Belgium) – In limonitic preservation are found *Schloenbachia varians*, *Sch. coupei*, *M. mantelli*, *Sci. baculoides* and *Scaphites* sp. juv., while in creamy-buff micritic limestone are *Sch. varians* and *Sci. roto*. The assemblage possibly indicates horizons between the Lower Cenomanian *Mantelliceras mantelli* Zone to the *Turrilites costatus* Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone. However, in view of the fact that there is no current evidence that the *Sharpeiceras schlueteri* and *Mantelliceras saxbii* subzones extend beyond the Boulonnais and Pernes-en-Artois, the sole well-identified Lower Cenomanian zone around the Mons Basin is the *Mantelliceras dixonii* Zone, which has been demonstrated at Loffre, Hautrage, Onnaing and Sassegny (Figs 1, 6-8). This is why we consider *Sch. varians*, *M. mantelli* and *Sci. roto* from Montignies-sur-Roc to be more probably indicative of the *Mantelliceras dixonii* Zone.

Fig. 5. Correlation of Cenomanian successions in the Tournai area. Ammonite taxa not listed in the recent paper by Amédro & Robaszynski (2010) are shown in bold.



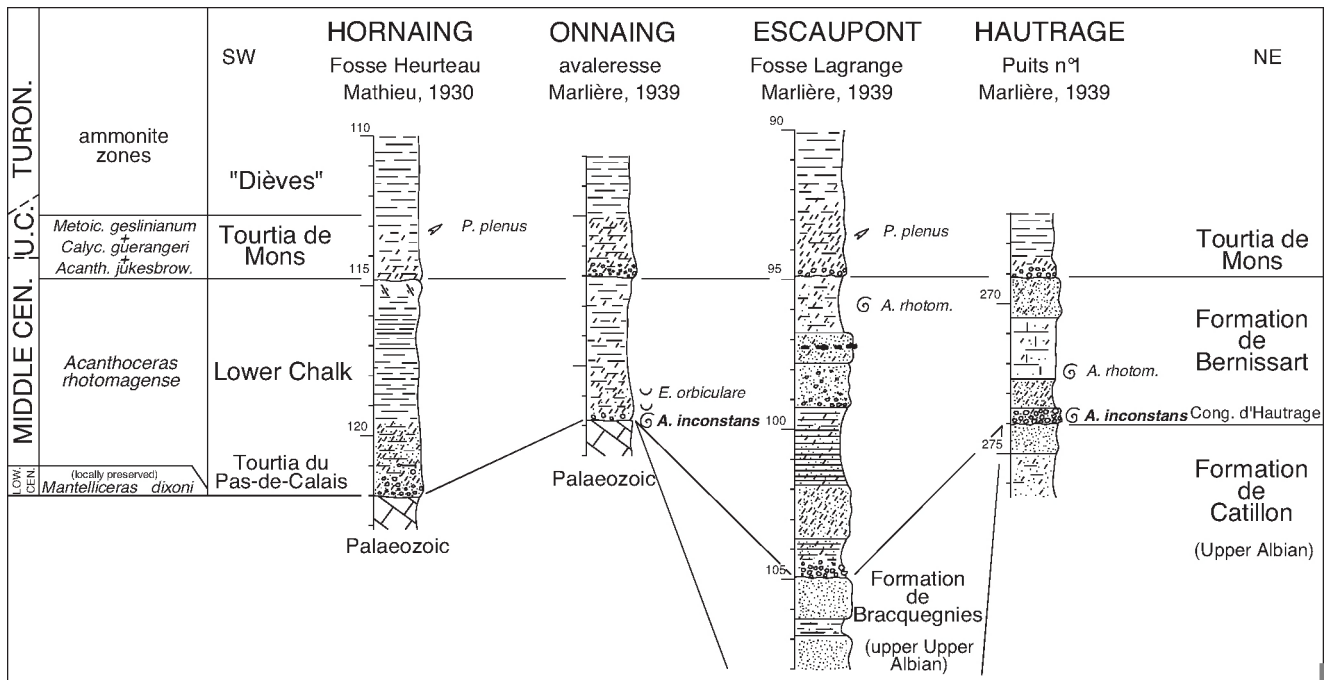


Fig. 6. Correlation of Cenomanian successions in the Valenciennes area (Hornaing, Onnaing) and the Mons Basin (Escaupont, Hautrage). Ammonite taxa not listed in the recent paper by Amédéo & Robaszynski (2010) are shown in bold.

Tourtia de Sassegnyes (Sassegnyes, northern France) – *Acompsoceras renevieri* and *A. inconstans* are preserved as slightly deformed, pale grey to beige internal moulds of rather coarse-grained, glauconitic calcarenite. These species of *Acompsoceras* range throughout the Lower Cenomanian in

western Europe, and are commonest in the *Mantelliceras dixonii* Zone. In fact, in the MHNH collections, Amédéo & Robaszynski (2010, pl. 3, fig. 4; pl. 4, fig. 2) noted *A. renevieri* and *M. dixonii* from the Tourtia de Sassegnyes, thus confirming the *Mantelliceras dixonii* Zone age for the present material.

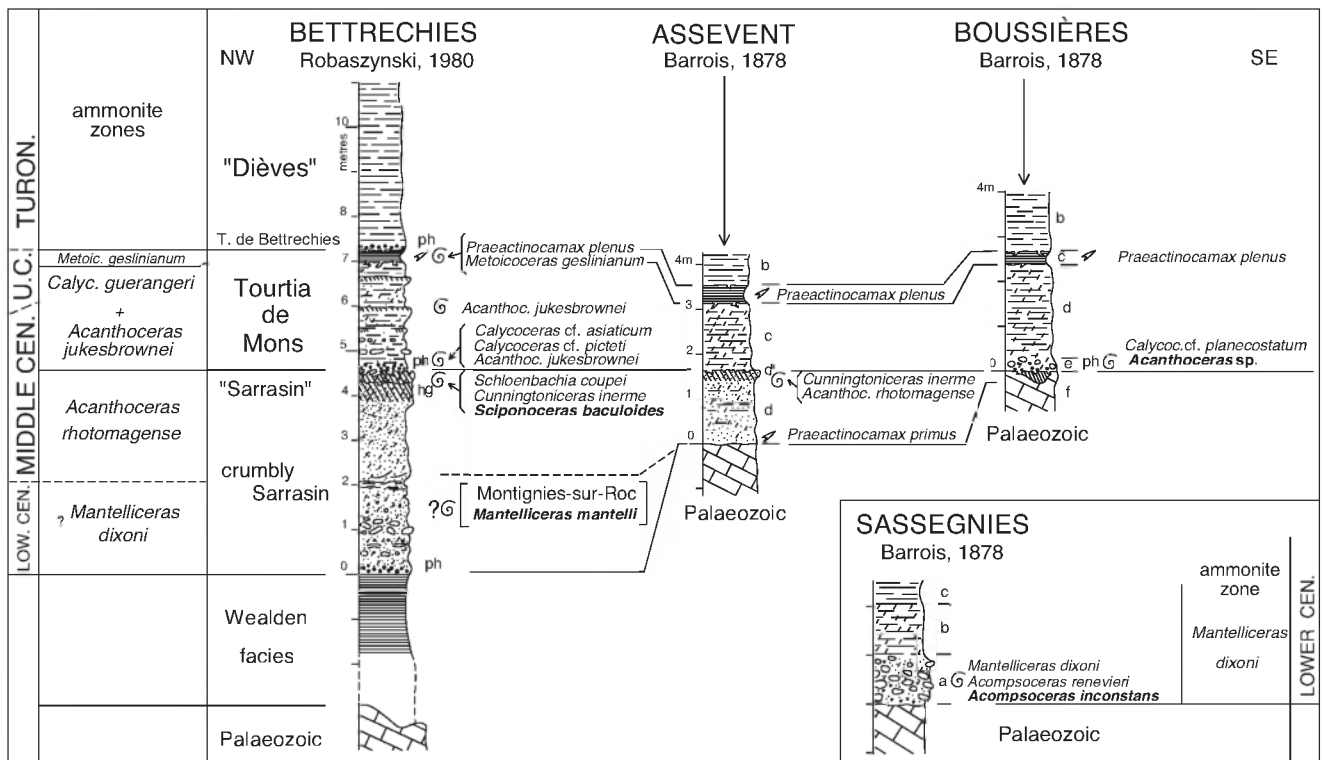


Fig. 7. Correlation of Cenomanian successions in the Maubeuge area (Bettrechies, Assevent, Boussières, Sassegnyes). Ammonite taxa not listed in the recent paper by Amédéo & Robaszynski (2010) are shown in bold.

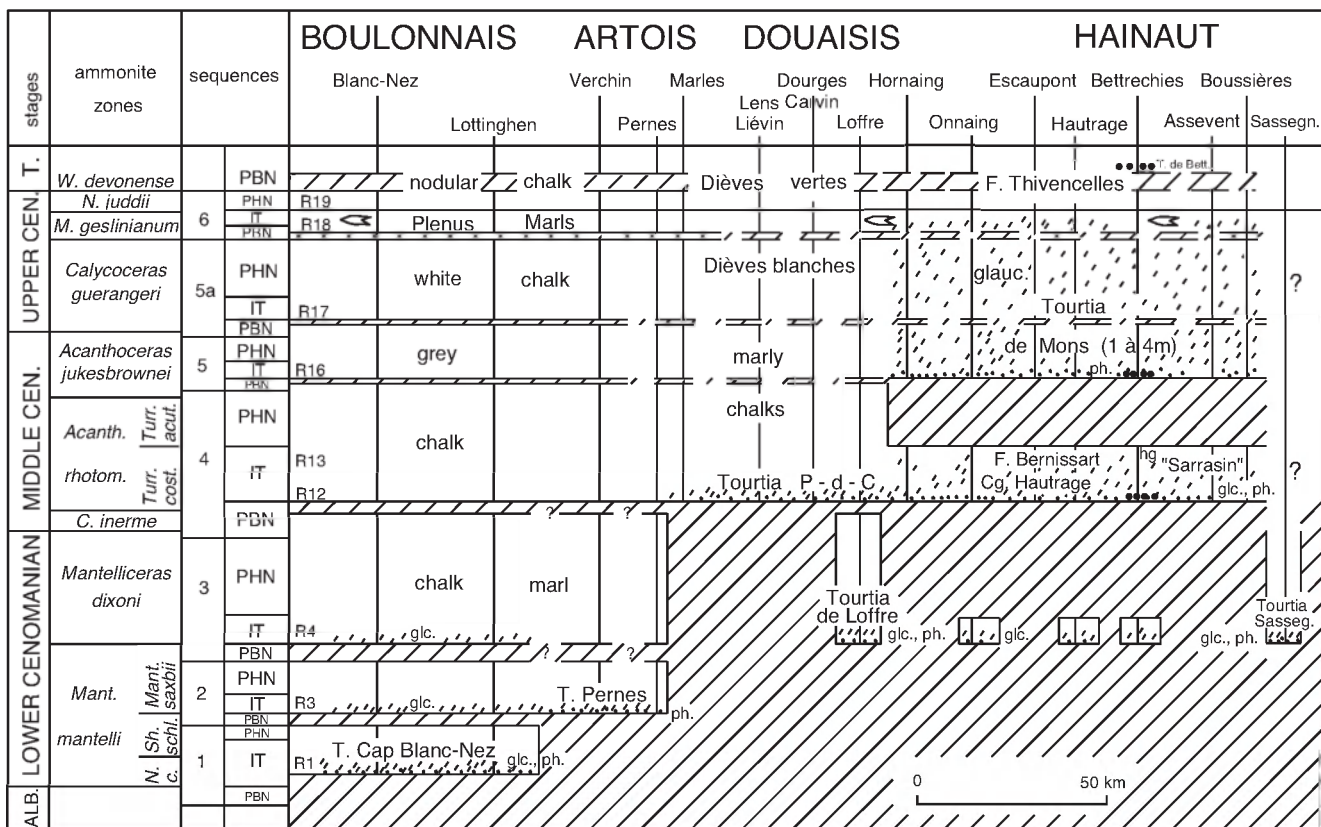
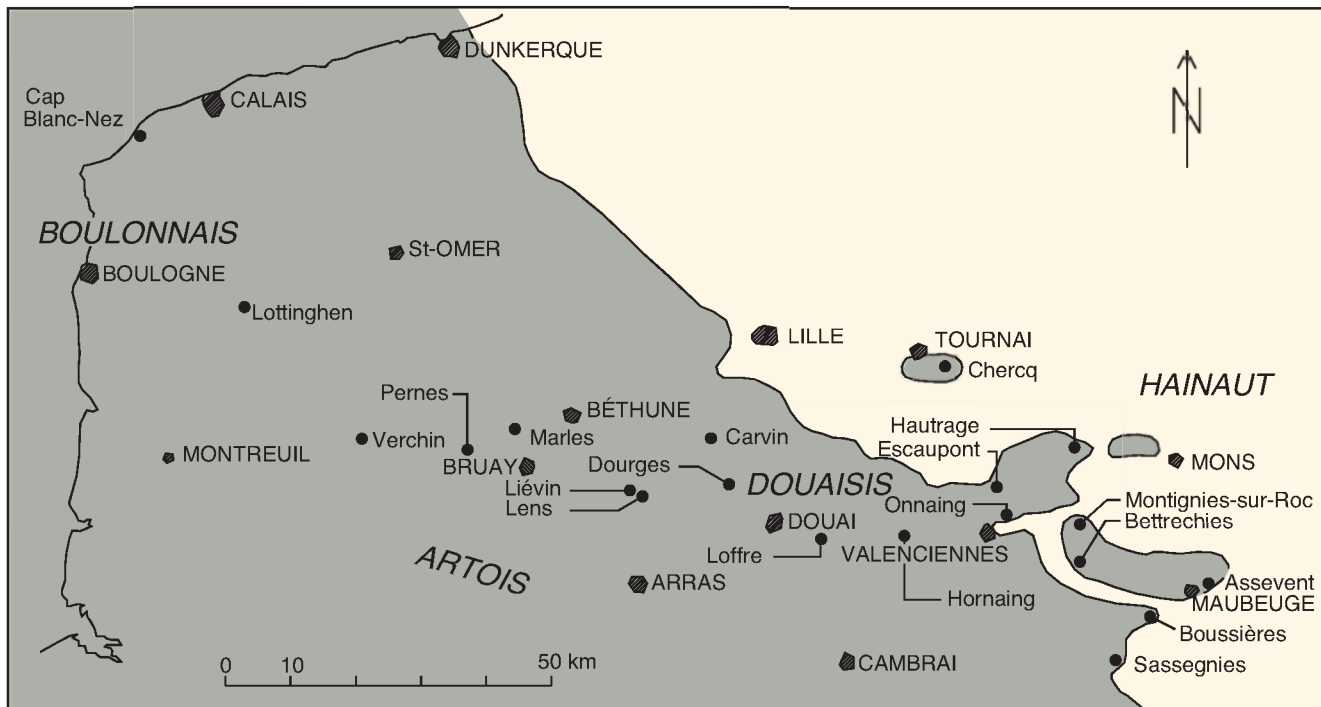


Fig. 8. Development of sequences and systems tracts in northern France and southern Belgium with the position of tourtias (modified from Amédéo & Robaszynski, 2010).

Meule de Bernissart (Hautrage, Onnaing, northern France) – *Acompsoceras inconstans* of Early Cenomanian, probably *Mantelliceras dixoni* Zone, age, and probably originating from the 'Conglomérat d'Hautrage' (Formation de Bernissart).

Tourtia de Mons (Boussières-sur-Sambre, near Hautmont, northern France) – Phosphatised (and remanié?) fragments of *Acanthoceras* sp., of Middle Cenomanian age.

Craie de Maisières (Thieu, Hainaut, southern Belgium) – *Lewesiceras* cf. *mantelli*, preserved in a fine-grained, glauconitic calcarenite. Here considered to be of Late Turonian age, as this level also contains large fragmentary shells of *Inoceramus mantelli*.

Marne Grise ('Dièves') (Autreppe, Hainaut, southern Belgium) – *Mammites nodosoides* and *Fagesia* sp., preserved as black phosphate. Both are of Early Turonian, *Mammites nodosoides* Zone, age (see also remarks above under 'Tourtia de Tournai').

Dièves (Anderlues, Hainaut, southern Belgium) – *Collignonicerias woollgari regulare* of Middle Turonian, *Collignonicerias woollgari* Zone, *C. w. regulare* Subzone, age.

Repositories of specimens

BGS.GSM: collections of the Geological Survey and Museum, currently housed at the British Geological Survey, Keyworth, Nottinghamshire, England; BMNH: The Natural History Museum, London (formerly British Museum of Natural History); EMP: École des Mines collections, Paris, now housed in the Université Claude Bernard, Lyon; IRScNB: Institut Royal des Sciences Naturelles de Belgique, Brussels; NHMW: Naturhistorisches Museum Wien, Vienna; OUM: Oxford University Museum of Natural History, Oxford, England; PIB: Paläontologisches Institut, Universität Bonn; RE: Ruhrländ Museum, Essen.

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. 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.

Systematic palaeontology

Order Ammonoidea von Zittel, 1884

Suborder Ammonitina Hyatt, 1889

Superfamily Desmoceratoidea von Zittel, 1895

Family Pachydiscidae Spath, 1922

Genus *Lewesiceras* Spath, 1939

Type species

Ammonites perampus Mantell, 1822, p. 200, by original designation (Spath, 1939, p. 296).

Lewesiceras sp. juv.

Material

IRScNB 11439 and IRScNB 11440, both labelled as coming from the 'Tourtia de Tournai' at Tournai (Hainaut), we rather consider these to have come from a higher level, e.g. the Tourtia de Mons, of latest Cenomanian age (see previous; Fig. 5).

Description

IRScNB 11439 (Fig. 9D-F, I-K) is a black phosphatised internal mould of a phragmocone, 28.3 mm in diameter, with patches of phosphatised shell and traces of brown limonitic encrustation. Coiling is moderately evolute, the umbilicus comprising an estimated 32 per cent of the diameter, the umbilical wall broadly rounded, the intercostal section depressed reniform, the costal section depressed polygonal, with the greatest breadth at the umbilical bullae. There are four strong umbilical bullae on the adapertural half whorl. They give rise to pairs of strong concave ribs that sweep forwards over the ventrolateral shoulder and cross the venter in a broad convexity. A single intercalated rib is present between the paired ribs at one point, while there are up to three weaker intercalated ribs (some incipiently bifurcate) that arise both low and high on the flank, and follow a course parallel to the primaries; they are most conspicuously developed on the ventrolateral shoulders and venter. At one point, the ventral development of the ribs becomes chevron-like, possibly the result of a short-term pathological condition. IRScNB 11440 (Fig. 9G, H, L, M) is a black phosphatised internal mould of a 90° sector of phragmocone fragment with a maximum preserved whorl height of 12.2 mm and a costal whorl breadth to height ratio of 1.16. There are two well-preserved bullae on the fragment that give rise to pairs of ribs, with four long or short ribs (some incipiently bifurcate) intercalated between successive pairs of bullate ribs. Interspaces adjacent to the primary ribs may be deepened into constrictions, as in the previous specimen. The suture is moderately incised, with symmetrically bifid E/A and A/U2 and trifid A.

Discussion

These two specimens are reminiscent of the holotype of *L. cenomanense* Wiedmann & Schneider, 1979 (p. 667, text-fig. 9a, b; pl. 9, fig. 6; see also Kaplan et al., 1998, p. 86, pl. 17, figs 1-3), although the bifurcation of the intercalated ribs is less pronounced. The present specimens differ from the Early Cenomanian *Lewesiceras wiedmanni* Wright & Kennedy, 1984 (p. 63, pl. 4, fig. 3) in the coarser ribbing, with only a single intercalated rib between successive pairs of primaries. *Lewesiceras mantelli* Wright & Wright, 1951 (p. 20) of comparable size have single primary ribs succeeded by strong constrictions, and coarse intercalated ribs that do not show incipient branching.

Fig. 9D-M.



Fig. 9A-C, P-R. *Lewesiceras cf. mantelli* Wright & Wright, 1951, IRScNB 11438, Craie de Maisières, Thieu (Hainaut); D-M. *Lewesiceras sp. juv.*, D-F, I-K are IRScNB 11439; G-H, L-M are IRScNB 11440, Tourtia de Tournai, Tournai (Hainaut); N, O. ?*Lewesiceras sp.*, IRScNB 11441, Tourtia de Tournai, Tournai (Hainaut); S, T. *Fagesia sp.*, IRScNB 11442, Marne Grise, Autreppe (Hainaut). A-H, N-O and S-T are $\times 1$; I-M and P-R are $\times 2$.

Occurrence

Labelled as 'Tourtia de Tournai', but more probably originating from the Tourtia de Mons, of Late Cenomanian (*Metoicoceras geslinianum* Zone) age, or from an even higher level, and therefore, for the time being, best left in open nomenclature.

Lewesiceras cf. mantelli Wright & Wright, 1951

Fig. 9A-C, P-R.

Compare:

1951 *Lewesiceras mantelli* Wright & Wright, p. 20.
1979 *Lewesiceras mantelli* Wright & Wright; Wright, p. 310, pl. 4, figs 1-3; pl. 6, figs 4, 5 (with synonymy).

Type

The holotype, by original designation, is BMNH 88587, the original of Sharpe (1853, pl. 10, fig. 3), from Oldbury Hill (Wiltshire, England), presumably from the Upper Turonian (*Subprionocyclus neptuni* Zone) Chalk Rock.

Material

IRScNB 11438, from the Craie de Maisières of Thieu, Hainaut.

Description

The specimen is a badly abraded internal mould 30 mm in diameter, preserved in a fine-grained glauconitic calcarenite. There are indications of the former presence of a further whorl or whorls. Coiling mode cannot be established. The whorl section is depressed reniform in intercostal section. Only the ventrolateral and ventral ornament is preserved. There are three strong primary ribs on the adapertural half whorl that are prorsiradiate and feebly concave on the ventrolateral shoulders and feebly convex on the venter. They are succeeded by a prominent constriction. There are traces of intercalated ribs between successive primaries, but their exact number cannot be established.

Discussion

Although poorly preserved, the pattern of primary ribbing and constrictions on this specimen suggest these to be *Lewesiceras mantelli*, although reference to *L. peramplum* (Mantell, 1822) (see revision in Wright & Kennedy, 1981, p. 29, text-figs 9-12; pl. 2, figs 1-3; pl. 3) cannot be excluded, hence the qualified interpretation.

Occurrence

The present specimen can be dated no more precisely than Turonian. *Lewesiceras mantelli* is known from the upper Middle and Upper Turonian of southern England, northern and southeast France, Germany, the Czech Republic and Ukraine.

Superfamily Hoplitoidea H. Douvillé, 1890

Genus Schloenbachia Neumayr, 1875

Type species

Ammonites varians J. Sowerby, 1817, p. 169, pl. 176, by the subsequent designation of H. Douvillé (1890, p. 290).

Discussion

Schloenbachia is by far the commonest ammonite in all tourtias predating the Tourtia de Mons, as e.g. the Tourtia de Tournai and the Tourtia de Montignies-sur-Roc, with more than thirty specimens seen. As discussed previously (see e.g., Juignet & Kennedy, 1976; Kennedy et al., 1979, 2008; Thome, 1992; Kaplan et al., 1998; Gale et al., 1999; Wilmsen & Mosavinia, 2011), study of large populations of *Schloenbachia* from any given horizon reveals wide, continuous intraspecific variation in juveniles and phragmocones from near-smooth to hypernodose individuals. Both large and small adults occur at any given horizon, indicating the presence of size-related dimorphism. There is also a change in ornament, and the proportion of variants through time. As a result, it is possible to identify the horizon of assemblages, and, in some cases individual specimens. The most obvious changes are the presence/absence and strength

of umbilical tubercles and the proportion of inflated individuals, which increase through the Lower and lower Middle Cenomanian, and adult size, which decreases markedly from lower Middle to upper Middle and Upper Cenomanian.

On this basis, *Schloenbachia varians* (J. Sowerby, 1817) from the Lower Cenomanian *Mantelliceras mantelli* Zone can be divided into a series of integrating 'formae' (Kennedy et al., 2008, p. 129) from compressed individuals, forma *subplana* (Mantell, 1822), forma *tollotiana* (Pictet, 1847), forma *subtuberculata* Sharpe, 1853, forma *tetrammata* J. de C. Sowerby, 1828, and *varians* sensu stricto, to the hypernodose forma *ventriosa* Stieler, 1922.

Schloenbachia from the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone are referred to a variable *Schloenbachia coupei* (Brongniart, 1822), divided into formae that range from compressed and feebly ornamented forma *costata* Sharpe, 1853, various as yet un-named morphotypes to forma *quadrata* Spath, 1926a, *coupei* sensu stricto, *trituberculata* Spath, 1926a, to an unnamed hypernodose variant.

Many of these formae are present in the higher parts of the upper Lower Cenomanian *Mantelliceras dixonii* Zone, and it is not readily possible to distinguish between assemblages from high in the *dixonii* Zone and those from the *Turrilites costatus* Subzone of the *Acanthoceras rhotomagense* Zone.

The Late Cenomanian *Schloenbachia lymensis* Spath, 1926a is highly distinctive, and characterised by very small adult size in addition to details of ornament.

A few of the ammonites from the tourtias, apart from *Schloenbachia*, indicate the presence of the Lower Cenomanian. Rather more individuals indicate the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone, *Turrilites costatus* Subzone, and a single *T. acutus* Passy, 1832, is indicative of the succeeding *Turrilites acutus* Subzone. There are no ammonite indicators of the upper Middle or Upper Cenomanian in the fauna. It is thus unsurprising that the numerically dominant *Schloenbachia* indicate a range of horizons. Those referred to *Schloenbachia varians* indicate the lower Lower Cenomanian *Mantelliceras mantelli* to *Mantelliceras dixonii* zones. The majority of individuals are referred either to *Schloenbachia coupei*, or transitions between this and *Sch. varians*, and indicate an interval spanning the upper part of the upper Lower Cenomanian *Mantelliceras dixonii* Zone to the *Turrilites costatus* Subzone of the lower Middle Cenomanian *Acanthoceras rhotomagense* Zone.

Schloenbachia varians (J. Sowerby, 1817)

Figs 10E, F, S-X, 11L-O, Q-T.

1817 *Ammonites varians* J. Sowerby, p. 169 (*pars*), p. 176 uppermost figure, figure in row below, right-hand figure in row below.

1822 *Ammonites varians* var. *subplana* Mantell, p. 166, pl. 21, fig. 2.

- 1822 *Ammonites varians* var. *intermedia* Mantell, p. 166, pl. 21, figs 5, 7.
- 1828 *Ammonites varians* var. *tetrammata* J. de C. Sowerby, p. 166, pl. 587, fig. 2.
- 1847 *Ammonites tollotianus* Pictet, p. 109, pl. 10, fig. 5.
- 1853 *Ammonites varians* var. *subtuberculata* Sharpe, p. 22, pl. 8, figs 5, 6.
- 1853 *Ammonites varians* var. *intermedia* Sharpe, p. 23, pl. 8, fig. 7 (*non* Mantell = *Sch. subvariens* Spath, 1926b).
- 1853 *Ammonites coupei* var. *inflata* Sharpe, p. 24, pl. 8, fig. 1 (= *Sch. ventriosa* Stieler, 1922).
- 1871 *Ammonites varians* Sowerby; Schlüter, p. 10 (*pars*), pl. 4, figs 1-19, 21 only (*non* fig. 20 = *Sch. coupei*).
- 1922 *Schloenbachia ventriosa* Stieler, p. 31.
- 1926a *Schloenbachia subvariens* Spath, p. 430.
- 1926a *Schloenbachia subvariens aperta* Spath, p. 430.
- 1926a *Schloenbachia subvariens densicostata* Spath, p. 430.
- 1926b *Schloenbachia subvariens* Spath, p. 81.
- 1928 *Schloenbachia ecarinata* Spath, p. 241.
- 1998 *Schloenbachia varians* (J. Sowerby, 1817); Kaplan et al., p. 107, pl. 10, fig. 12; pl. 11, fig. 5; pl. 12, figs 1-4, 6, 9-12; pl. 13, figs 3-5, 13, 14; pl. 14, figs 1-21; pl. 15, figs 1-13; pl. 16, figs 1-14 (with additional synonymy).
- 1999 *Schloenbachia varians* (J. Sowerby, 1817); Gale et al., pl. 1, figs 1, 2, 12-15.
- 2008 *Schloenbachia varians* (J. Sowerby, 1817); Kennedy et al., p. 129, pl. 5, figs 10-12, 14, 15; pl. 6, figs 3, 6-13.

Type

Lectotype, by the subsequent designation of Spath (1938, p. 544), is BMNH 43962b, the original of J. Sowerby (1817, pl. 176, top figure), from the Lower Chalk at an unknown locality in southern England.

Material

EMP335b and IRScNB 11450, from the Tourtia de Montignies-sur-Roc, Hainaut; IRScNB 11451, IRScNB 11453 and IRScNB 11479, all from the Tourtia de Tournai of Tournai, Hainaut; IRScNB 11452, IRScNB 11456 and IRScNB 11457, all from from the Tourtia de Tournai of Chercq, Hainaut; IRScNB 11482, from the Tourtia de Tournai of Hautrage, Hainaut.

Discussion

Amongst specimens referred to *Sch. varians* of the *Mantelliceras mantelli* Zone, forma *tollotiana* is well represented by individuals such as EMP 335b (Fig. 11L-O), IRScNB 11479 (Fig. 11S, T), IRScNB 11457 (Fig. 11Q-R) and IRScNB 11482 (not illustrated). In these compressed individuals the umbilical bullae are very weak to obsolete, the inner lateral tubercles stronger, but still tiny. They give rise to pairs of narrow flexuous ribs, with additional ribs intercalated between, the ribs convex on the inner flank, concave on the outer flank, and sweeping forwards to link to tiny ventral clavi. IRScNB 11451 (Fig. 10S-U) is a

transitional individual between forma *tollotiana* and forma *subtuberculata*, the latter represented by IRScNB 11452 (Fig. 10V, W). These specimens have very weak umbilical bullae, and stronger inner lateral tubercles. The rib pattern is more complex than in forma *tollotiana*. The ribs that arise from the lateral tubercles link to strong oblique ventral clavi. They are accompanied by intercalated ribs that are restricted to the outer flank, and are not linked to either an inner lateral or a ventrolateral tubercle.

Individuals such as IRScNB 11453 (Fig. 10X), IRScNB 11455 (Fig. 11K) and IRScNB 11456 (Fig. 11P) have the ribbing style of forma *tollotiana* combined with umbilical bullae that are only slightly weaker than, or equal in strength to, the lateral tubercle, suggesting a higher horizon in the Lower Cenomanian, possibly as high as the *Mantelliceras dixonii* Zone.

IRScNB 11450 (Fig. 10E, F) is a robustly ornamented fragment with strong inner lateral and more numerous ventrolateral tubercles, linked by low blunt ribs, and thus close to *variens* sensu stricto.

Occurrence

Lower Cenomanian of Northern Ireland, England, southern Belgium, France, Germany, Denmark (Bornholm), Switzerland, Poland, Ukraine, Kazakhstan, Turkmenistan, Iran and Greenland.

Schloenbachia coupei (Brongniart, 1822)

Figs 10A-D, G-R, 11D-J, U-Z.

- 1822 *Ammonites coupei* Brongniart, pl. N, fig. 3, 3a.
- 1851-1852 *Ammonites(?) coupei* Brongniart; Bronn, p. 317, pl. 33, fig. 4 (= *Sch. quadrata* Spath, 1926a).
- 1851-1852 *Ammonites varians* Sowerby; Bronn, p. 317, pl. 33, fig. 2 (*non* Sowerby; = *Sch. nodulosa* Stieler, 1922).
- 1853 *Ammonites varians* var. *costata* Sharpe, p. 23, pl. 8, fig. 9.
- 1853 *Ammonites coupei* var. *tuberculata* Mantell; Sharpe, p. 23, pl. 8, fig. 4 (*non* Mantell, = *Sch. trituberculata* Spath, 1926a).
- 1885 *Schloenbachia coupei* (Brongniart); Noetling; p. 236, pl. 8, fig. 1, 1a (= *Sch. atava* Spath, 1926a).
- 1885 *Schloenbachia coupei* (Brongniart); Noetling; p. 236, pl. 8, fig. 1 (= *Sch. devonensis* Spath, 1926a).
- 1922 *Schloenbachia nodulosa* Stieler, p. 32.
- 1926a *Schloenbachia trituberculata* Spath, p. 430.
- 1926a *Schloenbachia atava* Spath, p. 430.
- 1926a *Schloenbachia devonensis* Spath, p. 430.
- 1926a *Schloenbachia quadrata* Spath, pp. 426, 430.
- 1938 *Schloenbachia costata* (Sharpe); Spath, p. 546.
- 1976 *Schloenbachia coupei* (Brongniart); Juignet & Kennedy, p. 78, pl. 8, figs 4, 8-13; pl. 9, figs 1-9.
- 1998 *Schloenbachia coupei* (Brongniart, 1822); Kaplan et al., p. 108, pl. 12, figs 5, 7, 12, 14, 15; pl. 18, figs 4, 8 (with additional synonymy).



Fig. 10A-D, G-R. *Schloenbachia coupei* (Brongniart, 1822), A-C are IRScNB 11443, close to *forma trituberculata*, Tournai (Hainaut); D is IRScNB 11444, close to *coupei coupei*, Montignies-sur-Roc (Hainaut); G-I are IRScNB 11445, close to *forma nodulosa*, Tournai (Hainaut); J-L are IRScNB 11446, close to *coupei coupei*, Tournai (Hainaut); M, N are IRScNB 11447, *coupei coupei*, Chercq (Hainaut); O, P are IRScNB 11448, *forma nodosa*, Chercq (Hainaut); Q-R are IRScNB 11449, *forma nodulosa*, Tournai (Hainaut). E-F, S-X. *Schloenbachia varians* (J. Sowerby, 1817), E, F are IRScNB 11450, *varians varians*, Montignies-sur-Roc (Hainaut); S-U are IRScNB 11451, between *formae tollotiana* and *subtuberculata*, Tournai (Hainaut); V, W are IRScNB 11452, *forma subtuberculata*, Chercq (Hainaut); X is IRScNB 11453, *aff. forma tollotiana*, Tournai (Hainaut). All figures are $\times 1$.

Types

Brongniart's types, from the Middle Cenomanian of Rouen (Seine-Maritime, France) and in the Sorbonne Collections, are currently housed in the Université Pierre et Marie Curie, Paris VI.

Material

IRScNB 11448, from the Tourtia de Tournai of Chercq, Hainaut; IRScNB 11443, IRScNB 11445, IRScNB 11446, IRScNB 11449, IRScNB 11454, NHMW 1858 XX 5 and NHMW c.541, all from the Tourtia de Tournai of Tournai, Hainaut; EMP335a (ex Chaper Colln.) and IRScNB 11444, both from the Tourtia de Montignies-sur-Roc, Hainaut.

Discussion

Among individuals referred to *Sch. coupei* are variants with well-developed umbilical, inner lateral and ventral tubercles, the inner lateral and ventral tubercles linked by zigzag and incipiently looped ribs as in forma *nodulosa*: IRScNB 11448 (Fig. 100, P), IRScNB 11445 (Fig. 10G-I) and IRScNB 11449 (Fig. 10Q, R). A more compressed and feebly ribbed variant, to a degree transitional to forma *costata* is represented by IRScNB 11454 (Fig. 11H-J). Stouter, more robustly ornamented, individuals have well-developed umbilical, inner lateral and ventral tubercles, as well as coarse ribs, and are represented by specimens such as NHMW 1858 XX 5 (Fig. 11U-W), IRScNB 11447 (Fig. 10M, N), IRScNB 11446 (Fig. 10J-L) and IRScNB 11444 (Fig. 10D), and are variants around *coupei* sensu stricto. With increasing inflation, strengthening tuberculation and loss of ribs, forma *trituberculata* is approached, as represented by IRScNB 11443 (Fig. 10A-C).

These specimens, referred to *S. coupei*, indicate a horizon no higher than the lower *Turrilites costatus* Subzone of the *Acanthoceras rhotomagense* Zone, and some find a match in individuals from as low as the upper Lower Cenomanian *Mantelliceras dixonii* Zone.

Occurrence

Middle Cenomanian; the transition to *Sch. varians* takes place in the upper Lower Cenomanian *Mantelliceras dixonii* Zone. The geographic range extends from England, to southern Belgium, France (Pas-de-Calais to Alpes-Maritimes), Germany, Switzerland, Poland, to as far east as Khrebet Pay-Koy on the Kara Sea coast, and as far southeast as the Ukraine, the Mangyshlak Peninsula (Kazakhstan), Kopet Dagh (Turkmenistan) and Iran.

Superfamily Acanthoceratoidea De Grossouvre, 1894

Family Acanthoceratidae De Grossouvre, 1894

Subfamily Mantelliceratinae Hyatt, 1903

Genus Mantelliceras Hyatt, 1903

Type species

Ammonites mantelli J. Sowerby, 1814, p. 199 (ICZN Specific Name no. 1634).

Mantelliceras mantelli (J. Sowerby, 1814)

Fig. 11A-C.

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. 21, figs 2, 4; pl. 24, fig. 3; pl. 36, fig. 1; text-figs 20a-d, 26a, c, e (with full synonymy).

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).

Type

Lectotype, by the subsequent designation of Kennedy (1971, p. 52), is BMNH 43940a from the Lower Cenomanian Chalk Marl of Ringmer near Lewes (Sussex, England), the original of J. Sowerby (1814, pl. 55, lower figure only), reillustrated by Wright & Kennedy (1984, pl. 18, fig. 3a-c).

Material

An unregistered specimen in the EMP Collections (ex Deshayes Collection), from 'St Roc, Montignies', presumably Montignies-sur-Roc, Hainaut.

Dimensions

D	Wb	Wh	Wb:Wh	U
37.8 (100)	- (-)	17.3 (45.8)	-	10 (26.5)

Description

The specimen is a juvenile with a 90° sector of body chamber, and replaced, limonitised shell material. Coiling is moderately involute, the umbilicus comprising 26.5 per cent of the diameter, of moderate depth, with a flattened, subvertical wall and narrowly rounded umbilical shoulder. The whorl section is slightly compressed and octagonal in costal section. There are eight umbilical bullae on the 240° sector of outer whorl preserved. These increase markedly in strength as size increases. The bullae give rise to single straight, prorsiradiate primary ribs; there are also occasional non-bullate primaries, and one or two shorter intercalated ribs between successive primaries; these arise both high and low on the flanks, to give a total of 24 ribs per whorl at the ventrolateral shoulder. The bullate primary ribs bear a small lateral tubercle, and all ribs bear a small, conical inner, and a stronger outer ventrolateral tubercle, the latter connected over the venter by a relatively coarse transverse rib.

Discussion

Juveniles of *M. mantelli* are characterised by a polygonal whorl section with 32-40 ribs per whorl, alternating irregularly long and short. The long ribs have umbilical and lateral tubercles

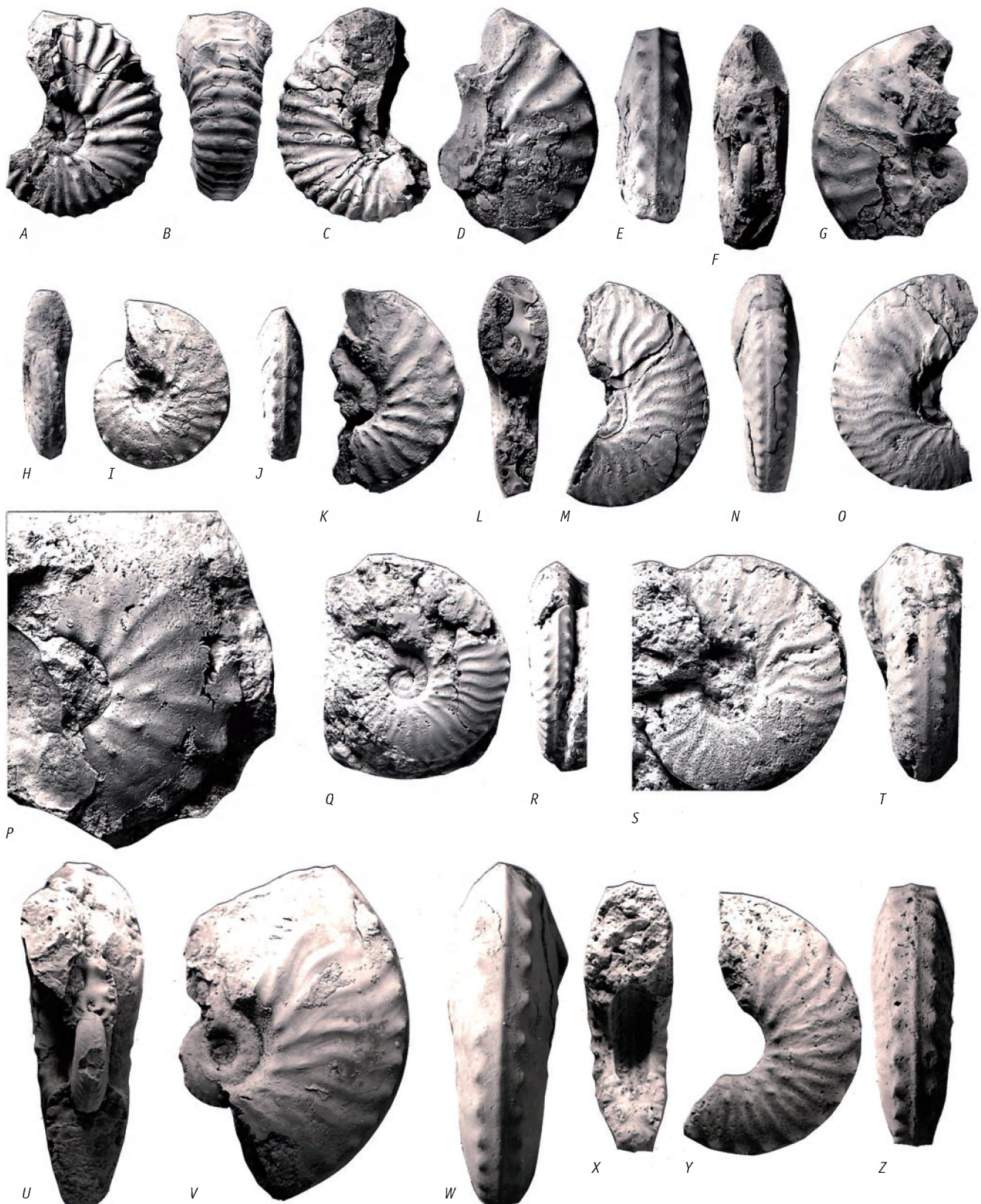


Fig. 11A-C. *Mantelliceras mantelli* (J. Sowerby, 1814), EMP unregistered (ex Deshayes Collection), Tourtia, presumably Montignies-sur-Roc (Hainaut); D-J, M, U-Z. *Schloenbachia coupei* (Brongniart, 1822), D-G are aff. forma *tollotiana* (EMP 335a, ex Chaper Collection), Tourtia, Montignies-sur-Roc (Hainaut); H-J are IRScNB 11454, forma *nodulosa*, Tourtia de Tournai, Tournai (Hainaut); U-W are NHMW 1858 XX 5, all aff. forma *tollotiana*, all Tourtia de Tournai, Tournai (Hainaut); X-Z are NHMW C.5416, close to forma *nodulosa*, Tourtia de Tournai, Tournai (Hainaut); K-P, Q-T. *Schloenbachia varians* (J. Sowerby, 1817) forma *tollotiana*, K is IRScNB 11455; L-O are EMP335b (ex Chaper Collection), Tourtia, Montignies-sur-Roc (Hainaut); P is IRScNB 11456; Q, R are IRScNB 11457, Tourtia de Tournai, Chercq (Hainaut); S, T are IRScNB 11479, Tourtia de Tournai, Tournai (Hainaut). All figures are $\times 1$.

and inner and outer ventrolateral clavi. The short ribs all bear inner and outer ventrolaterals while a few of the longer ones have the lateral tubercle as well. Microconchs of the species are adult at 60 mm; macroconchs are known to be up to 150 mm in diameter. Lateral and inner ventrolateral tubercles disappear on the adult body chamber, while the outer ventrolaterals decline or disappear to give a rounded venter.

Wright & Kennedy (1984, p. 99) outlined the reasons for regarding the species and varieties listed in their synonymy as inseparable from *M. mantelli*. The species is easily distinguished from *M. lymense* (Spath, 1926a), *M. couloni* (d'Orbigny, 1850) and *M. saxbii* (Sharpe, 1857), which are generally compressed and typically lack lateral tubercles. *Mantelliceras picteti* Hyatt, 1903 has a similar style of ribbing and tuberculation but the whorl section is quadrate and compressed, with rather distant ribbing at maturity, while *M. cantianum* Spath, 1926a is very inflated with a whorl section that expands rapidly during development, has a broad venter with strong ribs and feeble outer ventrolateral tubercles, inner ventrolateral tubercles that are lost early in ontogeny and strong lateral tubercles linked to a weak umbilical bulla by a strong rib.

Occurrence

The species is commonest in the *Mantelliceras mantelli* Zone of the Lower Cenomanian and is only rarely found in the succeeding *Mantelliceras dixonii* Zone. Apart from the present record from Hainaut, the species ranges from England to Northern Ireland (a doubtful record), Westfalen (Germany), the Boulonnais, Haute-Normandie, Sarthe, Maine, Argonne, Isère and south to Cassis (Bouches-du-Rhône) in France, the remainder of western Europe, Russia, North Africa, KwaZulu (South Africa), Madagascar and southern India.

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 (Hyatt, 1903, p. 111) = *Ammonites renevieri* Sharpe, 1857, p. 44, pl. 20, fig. 2.

Acompsoceras renevieri (Sharpe, 1857)

Fig. 12A-C.

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.

1871 *Ammonites Essendiensis* Schlüter, p. 3, pl. 1, figs 5-7; pl. 2, fig. 2.

1987 *Acompsoceras renevieri* (Sharpe, 1857); Wright & Kennedy, p. 140, text-fig. 34g, 35d-f, 36a-f, 37-40, 43d, e; pl. 43, fig. 2 (with full synonymy).

1998 *Acompsoceras renevieri* (Sharpe, 1857); Kaplan et al., p. 136, pl. 10, figs 6, 7; pls 34-35; pl. 36, figs 1-3; pl. 37, figs 4-6; pl. 38; pl. 40; pl. 41, figs 1, 5 (with additional synonymy).

Types

The lectotype, designated by Wright & Wright (1951, p. 38), is BGS.GSM 7753, from Blackdown (Isle of Wight, England), the original of Sharpe (1857, pl. 20, fig. 2); the paralectotypes have not been traced.



Fig. 12A-C. *Acompsoceras renevieri* (Sharpe, 1857), IRScNB 11458, Tourtia de Sassegnyes.

Material

IRScNB 11458, from the Tourtia de Sassegny, Sassegny, northern France (Fig. 7).

Description

IRScNB 11458 is a large phragmocone, 300 mm in diameter, of a rather involute form ($U = 80$ mm), with a compressed, flat-sided whorl section ($Wh = 140$ mm; $Wb = 93$ mm); the venter is tabulate in the middle growth stage and shows a series of feeble clavi; later the venter is more rounded. Inner whorls are not preserved; the ornament in the middle growth stage is poorly preserved, with only opposite ventral clavi visible. In later growth stages the ornament disappears. Deeply incised elements characterise the suture line, with subphyllid folioles; E/L is very wide and, more or less quadrate in outline, while L is bifid.

Discussion

Acompsoceras bochumensis and *A. essendiensis* (see Kaplan et al., 1998, pls 34, 35; pl. 37, figs 4-6) are synonyms of *A. renevieri*. *Acompsoceras inconstans* (see Kaplan et al., 1998, pl. 36, figs 4, 5; pl. 39) co-occurs with *A. renevieri*, from which it may be distinguished by the presence of a lateral tubercle in early and middle growth.

IRScNB 11458 is a slightly deformed internal mould, in rather coarse-grained, glauconitic calcarenite preservation, pale grey to beige (light brown) in colour, typical of level 'a' at Sassegny (compare Fig. 7 here; Amédro & Robaszynski, 2010).

Occurrence

Lower Cenomanian, especially the *Mantelliceras dixoni* Zone. There are records from southern England, Westfalen (Germany), Haute-Normandie, Sarthe and Provence in France, Poland, Algeria, Tunisia, Nigeria(?) and Madagascar. The species ranges into the lower Middle Cenomanian *Cunningtoniceras inerme* Zone in Tunisia.

Acompsoceras inconstans (Schlüter, 1871)

Figs 13A, B, 19M, N.

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

1987 *Acompsoceras inconstans* (Schlüter, 1871); Wright & Kennedy, p. 143, text-figs 34c, 41-42, 43a-c, 44; pl. 42, figs 4, 6, 7; pl. 43, fig. 1 (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 4, 5; pl. 37, figs 1-3; pl. 39; pl. 42, figs 3, 4 (with additional synonymy).

2010 *Acompsoceras renevieri* (Sharpe, 1857); Amédro & Robaszynski, p.35, pl. 4, fig. 2a, b.

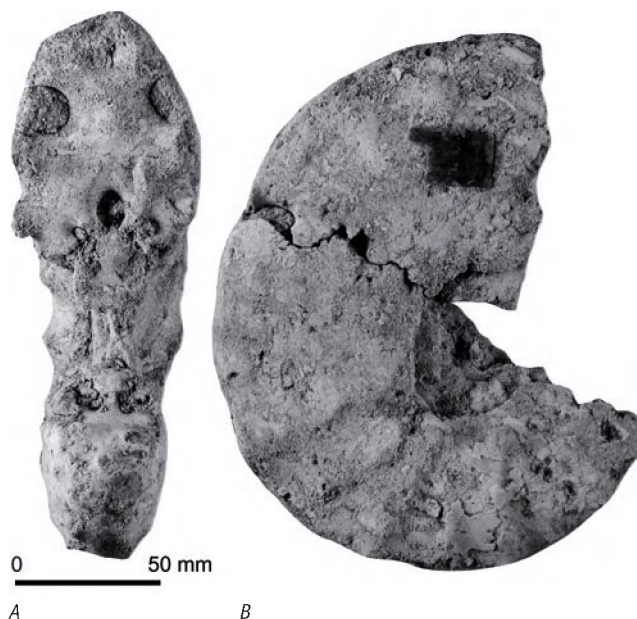


Fig. 13A, B. *Acompsoceras inconstans* (Schlüter, 1871), IRScNB 11459, Tourtia de Sassegny.

Types

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 (Kaplan et al., 1998, pl. 39); paralectotype PIB 30b is from the Lower Cenomanian Tourtia of Essen (Kaplan et al., 1998, pl. 36, figs 4, 5).

Material

IRScNB 11478, from the Meule de Bernissart of Onnaing-lès-Valenciennes, northern France; IRScNB 11459, from the Tourtia de Sassegny, Sassegny, northern France (Fig. 7).

Description

IRScNB 11478 (Fig. 19M, N) is a composite mould of a juvenile with a maximum preserved diameter of 84 mm. Coiling appears to have been moderately evolute. The whorls are high, the whorl section compressed. Straight prorsiradiate ribs arise from small umbilical bullae, and strengthen and broaden across the flanks, bearing small lateral bullae, conical inner and clavate outer ventrolateral tubercles. There are occasional shorter intercalated ribs that bear inner and outer ventrolateral tubercles only. There is a marked siphonal ridge, strengthened into incipient clavi opposite the outer ventrolateral clavi.

IRScNB 11459 (Fig. 13A, B) is a huge phragmocone, 183 mm in diameter ($U = 55$ mm; $Wh = 83$ mm; $Wb = 68$ mm). Although badly preserved, it clearly shows very coarse primary ribs with coarse umbilical, lateral, inner and outer ventrolateral tubercles.

Discussion

The presence of mid-lateral tubercles in early and middle growth characterises this species.

Occurrence

Lower Cenomanian, particularly the *Mantelliceras dixonii* Zone. There are records from southern England, Westfalen (Germany), Haute-Normandie, Sarthe and Provence in France; Algeria, Tunisia, Madagascar, Texas (USA) and northern Mexico.

Genus Acanthoceras Neumayr, 1875

Type species

Ammonites rhotomagense Brongniart, 1822, pp. 83, 391, pl. 6, fig. 2, by subsequent designation of De Grossouvre (1894, p. 27).

Acanthoceras rhotomagense (Brongniart, 1822)

Figs 14A, B, 15A-C.

1822 *Ammonites rhotomagensis* DeFrance; Brongniart, pp. 83, 391, pl. 6, fig. 2.

1987 *Acanthoceras rhotomagense* (Brongniart, 1822); Wright & Kennedy, p. 156, text-figs 47-54, 63f-j, 64a, b, 65a-d, k, 66a, f, g, j, 67a-g, 68, 69; 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; (with full synonymy).

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 (with additional synonymy).

Type

The lectotype, by subsequent designation of H. Douvillé (1912), is the original of Brongniart (1822, pl. 6, fig. 2), an unregistered specimen in the Sorbonne Collections, now in the collections of the Muséum national d'Histoire naturelle, Paris. It is from Rouen (Seine-Maritime, France; see Wright & Kennedy, 1987, text-fig. 63f-h).

Material

IRScNB 11460 and 11461, both from Tournai, Hainaut.

Dimensions

	D	Wb	Wh	Wb:Wh	U
IRScNB 11460	77.0 (100)	-(-)	33.0 (42.9)	-	21.5 (27.9)
	53.5 (100)	30.7 (57.4)	22.8 (42.6)	1.35	16.1 (29.1)
IRScNB 11461	94.5 (100)	54.0 (57.1)	40.5 (42.9)	1.26	31.8 (33.7)

Description

IRScNB 11460 (Fig. 14A, B) appears to be lightly phosphatised, with a conglomeratic infill. Coiling is evolute, the umbilicus comprising 28 per cent of the diameter, of moderate depth, with a feebly convex wall and more narrowly rounded umbilical shoulder. The whorl section is depressed, trapezoidal in intercostal section and polygonal in costal section, with a whorl breadth to height ratio of 1.35. There are 23 ribs per whorl at a diameter of 53.5 mm. Almost all of the ribs on the outer whorl are primaries; most of them are single and arise at feeble umbilical bullae; a few lack bullae. They are feebly flexed, broaden progressively across the flanks, projecting forwards, and are feebly concave on the outermost flank and ventrolateral shoulder. All ribs bear equal conical inner and clavate outer ventrolateral tubercles, the latter linked over the venter by a weak to effaced transverse rib, with a weak siphonal clavus.

IRScNB 11461 (Fig. 15A-C) is a more coarsely ornamented individual, with 24 ribs per whorl at a diameter of 94.5 mm. All of the ribs on the outer whorl are primaries, with stronger ventrolateral and ventral tuberculation. The specimen appears to be lightly phosphatised, and retains traces of phosphatised shell.



Fig. 14A, B. *Acanthoceras rhotomagense* (Brongniart, 1822), IRScNB 11460, Tourtia de Tournai, Tournai (Hainaut). Figures are $\times 1$.

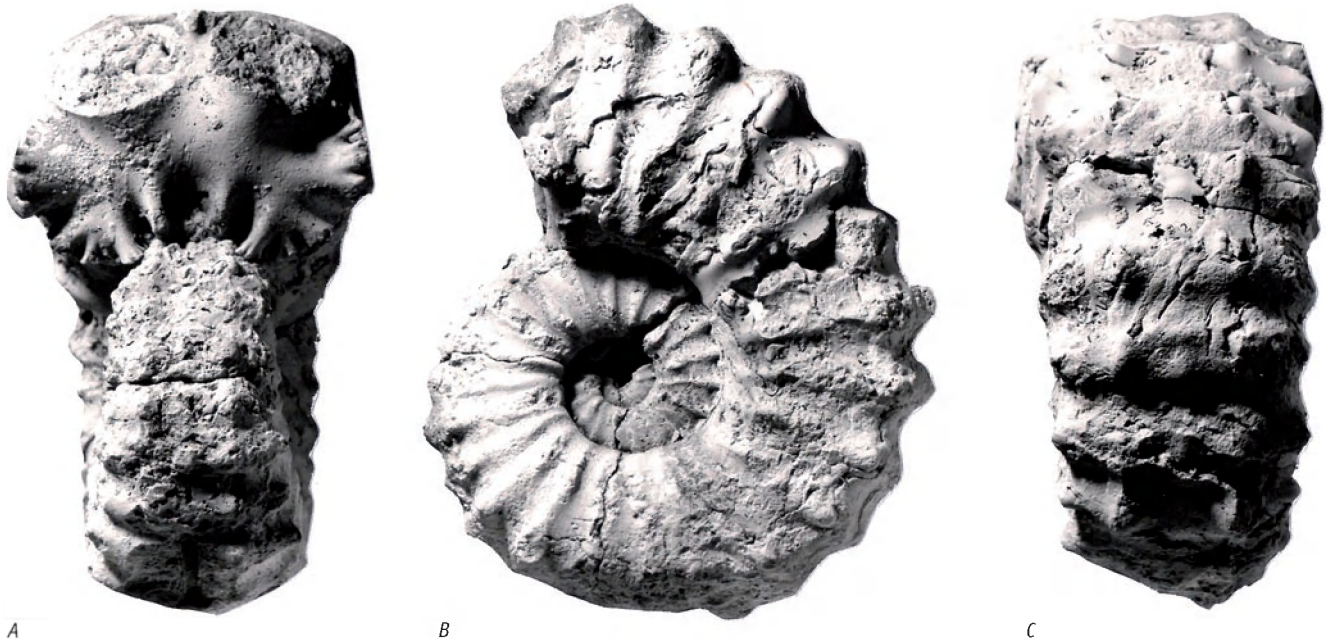


Fig. 15A-C. *Acanthoceras rhotomagense* (Brongniart, 1822), IRScNB 11461, Tourtia de Tournai, Tournai (Hainaut). Figures are $\times 0.8$.

Discussion

Kennedy & Hancock (1970) and Juignet & Kennedy (1976) provided extensive descriptions and numerous illustrations of topotypes and other material from Haute-Normandie, and Thomel (1972), under a variety of names, specimens from Provence. Wright & Kennedy (1987) placed a host of taxa in synonymy of a single variable species, described the variation, and illustrated a wealth of English material. IRScNB 11460 corresponds to a morphotype intermediate between *subflexuosum* of Spath (1923, p. 144, based on *Ammonites rhotomagensis* DeFrance of J. de C. Sowerby, 1826, pl. 515, fig. 1, reillustrated by Kennedy & Hancock, 1970, pl. 90, fig. 1) and *sussexiense* of Mantell, 1822 (p. 114, pl. 20, fig. 2; reillustrated by Wright & Kennedy, 1987, text-figs 51, 52). IRScNB 11461 is a *sussexiense* morphotype.

Acanthoceras rhotomagense is succeeded by *A. jukesbrownei* (Spath, 1926b) (p. 82; see revision in Wright & Kennedy, 1987, p. 191, text-figs 55-62, 64c, 65e, f, h-j, l, m, 67h-q; pl. 49, figs 2-4; pl. 50, figs 1-5; pl. 51, figs 1-7), 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. Differences from other species were discussed by Wright & Kennedy (1987, pp. 155, 187).

Occurrence

Middle Cenomanian, *Acanthoceras rhotomagense* Zone. The species occurs in western Europe from Northern Ireland through England, Westfalen (Germany), France (Boulonnais to Provence),

Denmark (Bornholm), northern Spain, east to Turkmenistan and northern Iran, Romania, North Africa, the Middle East, southern India, and possibly Peru and Bathurst Island, northern Australia.

Acanthoceras sp.

Fig. 16Q-T.

Material

IRScNB 11464 and IRScNB 11465, labelled 'assise de Saint Aybert, Tourtia de Mons, Boussières-sur-Sambre, près Hautmont', but more probably from Bed 'e' of Barrois (1878), which is the basal phosphatic nodule bed of the Tourtia de Mons in northern France (see Fig. 7).

Description

IRScNB 11465 (Fig. 16S, T) is a brown phosphatic internal mould of two chambers with a maximum preserved whorl breadth of 18 mm. The presence of strong subspinose inner ventrolateral tubercles and outer ventrolateral clavi and weaker siphonal clavi show this to be a juvenile *Acanthoceras*. IRScNB 11464 (Fig. 16Q, R) is a larger fragment of parts of three camerae in similar preservation, with traces of grey glauconitic chalky matrix. The maximum preserved whorl height is 28 mm. The whorl section appears to have been slightly depressed trapezoidal in intercostal section. Weak umbilical bullae give rise to weak prorsiradial ribs that broaden and strengthen across the flanks and bear weak inner, and stronger, clavate outer ventrolateral tubercles. A single intercalated rib separates successive primaries, and lacks an inner ventrolateral tubercle. The outer ventrolateral tubercles are linked across the venter by a low, broad, effaced rib. There are no clearly differentiated siphonal tubercles.

Discussion

These fragments belong to either *A. rhotomagense* or more probably, in view of their provenance, to *A. jukesbrownei* (Spath, 1926b) (see Wright & Kennedy, 1987, p. 191, text-figs 55-62, 64c, 65e, f, h-j, l, 66e, 67h-q; pl. 49, figs 2-4; pl. 50, figs 1-5; pl. 51, figs 1-7), but lack the clear differentiating features of the two species, as will be seen from a comparison of the larger of the two present specimens with the feebly ornamented *A. rhotomagense* illustrated by Wright & Kennedy (1987, pl. 44, fig. 11), and the feebly ornamented *A. jukesbrownei* figured as their pl. 51, fig. 5.

Occurrence

As for material; the specimens indicate either the Middle Cenomanian *Acanthoceras rhotomagense* or, more probably, the overlying *Acanthoceras jukesbrownei* Zone (see discussion in Amédro & Robaszynski, 2010, pp. 18, 20).

Subfamily Mammitinae Hyatt, 1900

Genus Mammites Laube & Bruder, 1887

Type species

Ammonites nodosoides Schlüter, 1871, p. 19, pl. 8, figs 1-4, by monotypy (see Wright & Kennedy, 1981, p. 75).

Mammites nodosoides (Schlüter, 1871)

Fig. 16A-P.

1871 *Ammonites nodosoides* Schlüter, p. 19, pl. 8, figs 1-4.

1981 *Mammites nodosoides* (Schlüter, 1871); Wright & Kennedy, p. 75, text-figs 19b, 23, 24; pl. 17, fig. 3; pl. 19, fig. 3; pl. 20, fig. 4; pl. 22, fig. 4; pl. 23, figs 1-3; pl. 24, figs 2, 3 (with synonymy).

2007 *Mammites nodosoides* (Schlüter, 1871); Barroso-Barcenilla, p. 148, pl. 11, figs a-d (with additional synonymy).

2008 *Mammites nodosoides* (Schlüter, 1871); Kennedy et al., p. 154, pl. 1, figs 1-5; pl. 2, fig. 8 (with additional synonymy).

2009 *Mammites nodosoides* (Schlüter, 1871); Lehmann & Herbig, p. 71, pl. 1, figs n, o.

Types

The lectotype, by subsequent designation of Wright & Kennedy (1981, p. 76), is no. C555 in the Museum für Naturkunde (Humboldt Universität Berlin), one of the syntypes on which Schlüter based his species (1871, p. 21, footnote 1), reillustrated Wright & Kennedy (1981, text-fig. 23). It is from the Lower Turonian of Měcholup, Czech Republic. There are two paralectotypes, both from the Lower Turonian of Westfalen (Germany).

Material

IRScNB 11462, from the Marne Grise of Autreppe, Hainaut, and IRScNB 11463, from above the Tourtia de Tournai of Tournai, Hainaut.

Description

IRScNB 11462 is a worn, brown-black phosphatic internal mould of a phragmocone with a maximum preserved diameter of 27 mm. Coiling is moderately involute, the umbilicus shallow, with a feebly convex umbilical wall and more narrowly rounded umbilical shoulder. The whorl section is compressed, rounded-trapezoidal in intercostal section and polygonal in costal section, with the greatest breadth at the umbilical bullae. There are an estimated 12 progressively strengthening subspinose umbilical bullae on the outer whorl. These give rise to strong straight prorsiradiate ribs that strengthen and broaden across the flanks and link to conical inner ventrolateral tubercles, linked in turn by a broad prorsiradiate rib to strong outer ventrolateral clavi. There are occasional non-bullate primary ribs and shorter intercalated ribs, all with inner and outer ventrolateral tubercles. The venter is narrow. The poorly preserved penultimate whorl (Fig. 16J) is closely and finely ribbed. The sutures are only partially preserved; E/A is broad and moderately incised, A is narrow, and A/U₂ small and moderately incised.

IRScNB 11463 (Fig. 16E-H, M-P) is a black phosphatic internal mould of a 180° sector of phragmocone with a maximum preserved diameter of 30 mm, with traces of grey chalky sediment with scattered small glauconite grains. Coiling appears to have been involute, with a small umbilicus. The umbilicus is shallow, with a low convex wall and more narrowly rounded umbilical shoulder. The intercostal whorl section is rectangular, with broadly rounded ventrolateral shoulders and a very feebly convex venter. The costal section is polygonal with the greatest breadth at the umbilical bullae, the rib profile concave between the umbilical bullae and the inner ventrolateral, inner and outer ventrolateral, and outer ventrolateral tubercles. Five small umbilical bullae are preserved on the fragment. They give rise to single low prorsiradiate ribs that broaden and strengthen across the flank, and a second rib may be tenuously linked to a bulla. There are non-bullate primaries and shorter intercalated ribs to give a total of nine ribs on the ventrolateral shoulder of the fragment, each bearing a conical inner ventrolateral tubercle. These tubercles are linked to somewhat larger outer ventrolateral clavi by a low, broad prorsiradiate rib. There is a very feeble siphonal ridge. The suture is moderately incised, with a broad asymmetrically bifid E/A, that declines from E to A, a narrow A, and simplifying A/U₂ and U₂/U₃.

Discussion

Although poorly preserved, these specimens are clearly *M. nodosoides*, IRScNB 11463 comparing well with a specimen from New Mexico illustrated by Cobban & Hook (1983, pl. 4, figs 4-6),



Fig. 16A-P. *Mammites nodosoides* (Schlüter, 1871); A-D, I-L are IRScNB 11462, Marne Grise, Autreppe (Hainaut); E-H, M-P are IRScNB 11463, Tourtia de Tournai, Tournai (Hainaut); Q-T. *Acanthoceras* sp., Q-R are IRScNB 11464; S, T are IRScNB 11465, Tourtia de Mons, Boussières-sur-Sambre, near Hautmont (Nord, France). Figures A-H, Q-T are $\times 1$; I-P are $\times 2$.

which, although larger and more inflated, shows the same relatively finely ribbed nucleus at the same diameter as the present specimen. The other specimen, IRScNB 11462, matches juveniles of this species figured by Cobban & Hook (1983, pl. 4, figs 4-9). The matrix remains in the latter clearly shows that it cannot have originated from the Tourtia de Tournai, but rather must be from a higher level, within the 'Dièves'.

Occurrence

Upper lower Turonian *Mammites nodosoides* Zone and correlatives, with records from Germany, France, southern Belgium, England, Spain, the Czech Republic, Romania, Turkmenistan, Lebanon, Israel, Egypt, Tunisia, Algeria, Morocco, Nigeria, Madagascar, Peru, Brazil, Colombia, Mexico and the United States Western Interior.

Family Vascocheratidae H. Douvillé, 1912

Genus Fagesia Pervinquier, 1907

Type species

Olcostephanus superstes Kossmat, 1897, p. 26 (133), pl. 6 (17), fig. 1 only, by original designation (Pervinquier, 1907, p. 322).

Fagesia sp.

Fig. 9S, T.

Material

IRScNB 11442, from the 'Marne Grise' (or 'Dièves') of Autreppe, Hainaut.

Description

The specimen is a worn black phosphatic internal mould of a single chamber. The coiling can be reconstructed as very evolute, with a large, deep, crater-like umbilicus, the umbilical wall flattened and outward-inclined, the umbilical shoulder narrowly rounded. The whorl section is very depressed, with a maximum preserved whorl height of 21.2 mm and a whorl breadth to height ratio of 1.92. There are no flanks. The venter is very wide and broadly convex. A coarse bulla perches on the umbilical shoulder of the single camera, and gives rise to a single broad, coarse rib that crosses the venter in a broad convexity.

Discussion

Although only a single chamber, this fragment is immediately recognisable as a ribbed *Fagesia* with umbilical bullae. There are close similarities to juvenile *Fagesia catinus* (Mantell, 1822) of comparable size, for example well-preserved individuals illustrated by Cobban et al. (1989, pl. 92, figs L-KK).

Occurrence

Fagesia ranges from the upper Upper Cenomanian to the Middle Turonian.

Family Collignoniceratidae Wright & Wright, 1951

Subfamily Collignoniceratinae Wright & Wright, 1951

Genus Collignoniceras Breistroffer, 1947

Type species

Ammonites woollgari Mantell, 1822, p. 197, pl. 21, fig. 16; pl. 22, fig. 7, by the original designation of Meek (1876, p. 453), as type species of *Prionotropis* Meek, 1876 non Fieber, 1853, for which Breistroffer (1947, unpaginated) proposed *Collignoniceras* as *nomen novum*.

Collignoniceras woollgari regulare (Haas, 1946)

Fig. 17A, B.

2001 *Collignoniceras woollgari regulare* (Haas, 1946); Kennedy et al., p. 45, figs 17-33, 49L (with full synonymy).

Type

The holotype, by original designation, is no. 1470 in the collections of the South Dakota School of Mines, Rapid City, the original of Haas (1946, text-figs 80, 81; pl. 16, figs 14, 16), from an unknown horizon and locality in the Black Hills area of South Dakota, USA.

Material

IRScNB 11466 and IRScNB 11483, from the 'Dièves' at Anderlues, Hainaut.

Description

IRScNB 11466 and IRScNB 11483 are distorted composite moulds with a thin surface coating of black pyrite, preserved in grey marl with scattered glauconite grains. IRScNB 11466 (Fig. 17A, B) is a 90 mm long fragment, crushed dorso-ventrally. Three strong bullae perch on the umbilical shoulder and give rise to single strong, narrow ribs that link to coarse inner ventrolateral clavi. There is a single shorter intercalated rib on the fragment, with an inner ventrolateral clavus. The inner ventrolateral clavi are linked to weaker outer ventrolateral clavi by a low broad swelling, sometimes incipiently differentiated into a pair of looped ribs. The venter is badly damaged, but one rib bears a weak siphonal clavus at mid-venter. IRScNB 11483 (not illustrated), a 100 mm long fragment, has been similarly deformed. It bears three narrow strong ribs that bear massive inner ventrolateral horns and weaker outer ventrolateral clavi. Any mid-ventral ornament has been obliterated by the crushing.

Discussion

Poor as this material is, it clearly belongs to *C. woollgari*. Two subspecies are recognised, as revised by Kennedy et al. (2001). *Collignoniceras w. woollgari* and *C. w. regulare* differ in that the nominate subspecies has more siphonal than ventrolateral tubercles on middle and late phragmocone whorls, and looped

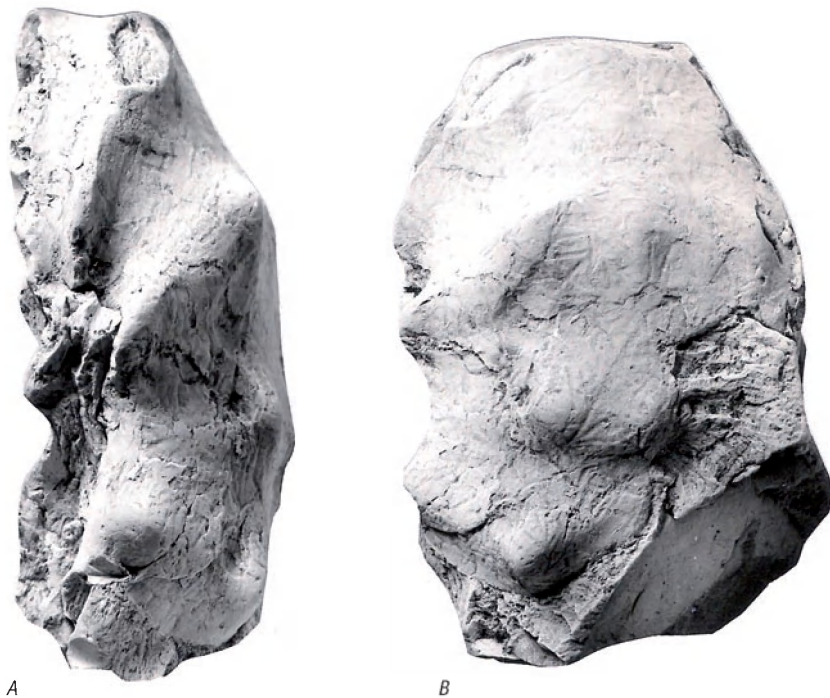


Fig. 17A, B. *Collignoniceras woollgari regulare* (Haas, 1946), IRScNB 11466, 'Dièves', Anderlues (Hainaut). Figures are $\times 1$.

ribs connecting opposite ventrolateral horns. These features also generally separate adult body chambers.

Occurrence

Upper part of the Middle Turonian *Collignoniceras woollgari* Zone, with records from southern England, southern Belgium, France, the US Western Interior, California, Oregon, and Chihuahua, northern Mexico.

Suborder Ancyloceratina Wiedmann, 1966

Superfamily Turritoidea Gill, 1871

Family Hamitidae Gill, 1871

Genus Hamites Parkinson, 1811

Type species

Hamites alternatus J. Sowerby, 1814, p. 137, pl. 61, figs 4, 5, by subsequent designation of Diener (1925, p. 65).

Hamites simplex d'Orbigny, 1842

Fig. 19H, I.

1842 *Hamites simplex* d'Orbigny, p. 550, pl. 134, figs 12-14.

1995 *Hamites simplex* d'Orbigny; Wright & Kennedy, p. 296, text-figs 128c, 131e-h, m, o, 133d-l; pl. 87, figs 6, 9, 11-13, 15-18; pl. 88, figs 11-13 (with full synonymy).

2006 *Hamites simplex* d'Orbigny; Kennedy & Juignet in Gauthier, p. 162, pl. 51, figs 4-11.

Types

Sornay (1955, fig. 1) designated a lectotype from amongst d'Orbigny's eight surviving syntypes. The specimens were

reillustrated by Wright & Kennedy (1995, text-fig. 133d-l), and Kennedy & Juignet in Gauthier (2006, pl. 51, figs 4-11), and are from the Middle Cenomanian of Rouen (Seine-Maritime, France).

Material

IRScNB 11476, from the Tourtia de Tournai of Tournai, Hainaut.

Description

The specimen is a 22.5 mm long limonitic internal mould retaining traces of iridescent limonitised shell. The fragment is straight, with a maximum preserved whorl height of 8 mm. The whorl section is circular, the rib index 5. The ribs are weakened and transverse on the dorsum, strengthen across the dorsolateral margin, and are narrow, sharp, straight and feebly prorsiradiate across the flanks, and transverse on the venter. At the adapertural end, a markedly strengthened rib is succeeded by a broad and deep constriction, in turn succeeded by a single, weaker rib, showing the specimen to be from the adapertural end of the body chamber of an adult microconch.

Discussion

Hamites simplex differs from *H. duplicatus* Pictet & Campiche, 1861 (p. 98; see revision in Wright & Kennedy, 1995, p. 298, pl. 87, figs 1, 2, 7, 8, 10; pl. 88, figs 2, 4) in that the latter has a much higher rib index (7-9), the ribs being fine and dense, with a tendency to split into two lirae on internal moulds.

Occurrence

The species ranges from the Lower Cenomanian *Mantelliceras mantelli* Zone, where it is rare, through the Middle Cenomanian *Acanthoceras rhotomagense* and *Acanthoceras jukesbrownei* zones, where it is commoner, into the Upper Cenomanian

Calycocheras guerangeri Zone, where it is again infrequent. The geographic range extends from southern England to Hainaut, southern Belgium, France (Boulonnais south to the Mediterranean coast at Cassis, Bouches-du-Rhône), Poland, Iran, Daghestan, Algeria, Tunisia, Madagascar, Bathurst Island (northern Australia) and the US Western Interior.

Family *Turrilitidae* Gill, 1871
Genus *Turrilites* Lamarck, 1801

Type species

Turrilites costatus Lamarck, 1801, p. 102, by original designation.

Turrilites acutus Passy, 1832

Fig. 20.

1832 *Turrilites acutus* Passy, p. 9, pl. 16, figs 3, 4.

1996 *Turrilites acutus* Passy, 1832; Wright & Kennedy, p. 358, text-figs 138m, 141a, 146n, o; pl. 103, fig. 3; pl. 104, figs 5, 7, 11; pl. 105, fig. 21; pl. 108, figs 1-4, 8, 11, 12 (with full synonymy).

1998 *Turrilites acutus* Passy, 1832; Kaplan et al., p. 216, pl. 60, fig. 4; pl. 63, figs 1-5; pl. 64, fig. 2.

Type

The lectotype, by subsequent designation of Juignet & Kennedy (1976, p. 65), is the original of Passy (1832, pl. 16, fig. 3), an unregistered specimen from the Middle Cenomanian of Rouen (Seine-Maritime, France) in the Sorbonne Collections, now housed at the Muséum national d'Histoire naturelle (Paris).

Material

NHMW 1857 XX 6, from Tournai, Hainaut.

Description

The specimen consists of three whorls, in typical limonitic preservation, with limonitised shell retained. The total height of the fragment is 30 mm. There are 18 ribs per whorl. They arise at the top of the outer whorl face and strengthen into sharp tubercles at a marked angulation in the whorl profile. A feeble prorsiradiate rib links to a second row of conical, feebly spirally elongated tubercles low on the outer whorl face. A third row of smaller tubercles is partially concealed in the interwhorl suture.

Discussion

Turrilites acutus most closely resembles *T. costatus*, from which it probably arose. The two differ in that the former has a lower whorl, ornamented by three rows of tubercles linked by weak or no ribs; in *T. costatus*, a strong rib covers the upper half of the outer whorl face, terminating in a variably developed tubercle or not, with two rows of tubercles below.

Occurrence

Middle Cenomanian, upper half of the *Acanthoceras rhotomagense* Zone, to lower Upper Cenomanian *Calycocheras guerangeri* Zone. The species occurs widely across Europe and Central Asia to Kazakhstan and Turkmenistan, in North Africa, the Middle East, Nigeria, Angola, Zululand (South Africa), Mozambique, Madagascar, Tibet, Texas, the US Western Interior and California.

Genus *Mesoturrilites* Breistroffer, 1953

Type species

Turrilites aumalensis Coquand, 1862, p. 323, pl. 35, fig. 5, by original designation (Breistroffer, 1953, p. 1351).

Mesoturrilites corrugatus Wright & Kennedy, 1996

Fig. 19C.

?1876 *Turrilites puzosianus* d'Orbigny; Schlüter, p. 128, pl. 38, figs 13, 14.

1974 *Ostlingoceras* (*Ostlingoceras*) *puzosianum* (d'Orbigny); Marcinowski, p. 170, pl. 32, fig. 6.

1996 *Mesoturrilites corrugatus* Wright & Kennedy, p. 348, pl. 98, figs 4, 17.

1998 *Mesoturrilites corrugatus* Wright & Kennedy; Kaplan et al., p. 212, pl. 65, figs 4, 5.

Types

The holotype is BGS.GSM Zb692, the original of Wright & Kennedy (1996, pl. 98, fig. 4) from the Lower Cenomanian *Hypoturrilites carcitanense* Subzone fauna of the *Mantelliceras mantelli* Zone near Norton Ferris (Wiltshire, England). Paratype OUM K38108 is the original of Wright & Kennedy (1996, pl. 98, fig. 17) from the Lower Cenomanian *Mantelliceras dixonii* Zone fauna of the Lower Chalk of Southerham, near Lewes (Sussex, England).

Material

IRScNB 11474, from the Tourtia de Tournai of Tournai.

Description

The specimen is a limonitised fragment of 1.25 whorls, retaining limonitised shell. The adapical end is a septal face. The maximum preserved whorl height is 6.1 mm. The apical angle is low. The upper part of the outer, exposed whorl face is convex, the remainder flattened. There are 19 ribs per whorl. They are coarse, rounded, straight and normal to the upper interwhorl suture, at which they arise, and extend across the upper half of the outer whorl face. They efface, and a broad near-smooth zone separates them from a similar number of rounded, spirally elongated tubercles. A narrow groove separates these tubercles from a spiral ridge, strengthened into weak spirally elongated tubercles that alternate in position with those in the row

above, and are concealed beneath the interwhorl suture. The base of the whorl bears delicate concave ribs that arise from these tubercles, together with growth lines and striae, all of which weaken towards the umbilicus.

Discussion

The species differs from congeners in being ribbed, rather than tuberculate. It is superficially similar to juvenile *Turrilites scheuchzerianus* Bosc, 1801, of similar size (see e.g., Gale et al., 1999, pl. 1, figs 23-25), from which it is distinguished by the presence of two rows of tubercles in addition to the ribs, rather than being ornamented by ribs that are weakened and effaced at mid-flank in juveniles.

Occurrence

Apart from the present record, the species is known from Lower Cenomanian (*Mantelliceras mantelli* and *Mantelliceras dixoni* zones) of southern England, the undifferentiated Cenomanian of Westfalen (Germany) and the condensed Upper Albian to Cenomanian of Poland.

Family *Baculitidae* Gill, 1871

Genus *Sciponoceras* Hyatt, 1894

Type species

Hamites baculoides Mantell, 1822, p. 123, pl. 23, figs 6, 7, by original designation (Hyatt, 1894, p. 578).

Sciponoceras baculoides (Mantell, 1822)

Fig. 18A-R.

1822 *Hamites baculoides* Mantell, p. 123, pl. 23, figs 6, 7.

1995 *Sciponoceras baculoides* (Mantell, 1822); Wright & Kennedy, p. 317, text-figs 129h, 132r, 133a-c, m-ff; pl. 95, figs 1-3, 5-10; pl. 96, figs 1-7; pl. 97, figs 1-5; pl. 98, figs 29-32 (with full synonymy).

1998 *Sciponoceras baculoides* (Mantell, 1822); Kaplan et al., p. 188, pl. 59, figs 6-11.

Types

The lectotype, by the subsequent designation of Kennedy (1971, p. 9), is the larger specimen of two on BMNH 8612 (Wright & Kennedy, 1995, pl. 95, fig. 9). Paralectotypes are the smaller specimen on BMNH 8612 and BMNH 3657a (Wright & Kennedy, 1995, pl. 95, fig. 7). All are from the Lower Chalk, presumed Middle Cenomanian, of Hamsey (Sussex, England).

Material

IRScNB 11467-11470 and IRScNB 11481, all from the Tourtia de Tournai of Tournai, Hainaut; IRScNB 11471, from the Tourtia de Tournai of Carrière Delwart, Pont-à-Rieu, Chercq, near Tournai, Hainaut; IRScNB 11472, from the Tourtia de Tournai of Carrière

du Cornet, Chercq, near Tournai, Hainaut; BMNH 30819a, b from the Tourtia de Montignies-sur-Roc.

Description

Specimens occur in two different preservation styles. IRScNB 11467, 11468, 11470, 11481 and BMNH 30819a, b are limonitised, and retain traces of limonitised shell. IRScNB 11469 is preserved in pale-buff micritic and possibly phosphatised limestone with phosphatised shell and only traces of limonite staining. In contrast, the Chercq specimens are preserved as internal moulds in off-white, fine-grained limestone with abundant small glauconite grains. Phragmocones such as IRScNB 11470 (Fig. 18P-R) have whorl heights of as little as 5.7 mm, with a compressed ovoid whorl section, the venter slightly more rounded than the dorsum. The whorls expand very slowly. Internal moulds of phragmocones are smooth but for periodic prominent constrictions, one in a distance equal to twice the whorl height. The constrictions are transverse and weak on the dorsum, strengthening markedly on the dorsolateral margin, producing a distinctive dorsal appearance (Fig. 18C, D, P). They are strongly prorsiradiate on the flanks, and cross the venter in a broad convexity. Well-preserved body chambers have whorl heights of up to 11.5 mm (Fig. 18G-L), and develop distinctive prorsiradiate ribs on the outer flank that cross the venter in a broad convexity, where they have a scale-like appearance, the adapical slope of the rib gently inclined, the adapertural slope steep.

IRScNB 11481 are much larger fragments of body chamber, with whorl heights of up to 16 mm, while IRScNB 11470 shows the suture, with moderately incised, strongly bifid E/A, A, A/U, U, and U/I.

Discussion

Wright & Kennedy (1995, p. 318) are referred to for an extensive description and discussion of this species. *Sciponoceras baculoides* differs from *Sci. roto* Cieřliński, 1959 (pp. 39, 75, 89, text-fig. 14(2); pl. 4, fig. 10) in that the latter has a circular rather than oval whorl section, and more widely spaced, feeble constrictions separated by a distance of up to three whorl heights (see below).

Occurrence

This is the second commonest ammonite in the fauna of the Tourtia de Tournai. In southern England, *Sci. baculoides* occurs in flood abundance at the top of the Middle Cenomanian *Turrilites costatus* Subzone of the *Acanthoceras rhotomagense* Zone in the Lower Chalk, and in the phosphatised faunas of the Chalk Basement bed of comparable age in Dorset. It ranges to the lower Upper Cenomanian *Calycoceras guerangeri* Zone. The species is also known from Westfalen (Germany), France, Switzerland, Poland, Romania, North Africa, Madagascar, Zululand (South Africa), South India, Japan (as a subspecies) and California.



Fig. 18A-R. *Sciponoceras baculoides* (Mantell, 1822), A-C are IRScNB 11467; G-I are IRScNB 11468; J-L are IRScNB 11469; P-R are IRScNB 11470, Tourtia de Tournai, Tournai (Hainaut); D-F are IRScNB 11471; M-O are IRScNB 11472, Tourtia de Tournai, Chercq (Hainaut). All figures are $\times 2$.

Sciponoceras roto Ciesliński, 1959

Fig. 19J-L.

1959 *Sciponoceras roto* Ciesliński, pp. 39, 75, 89, text-fig. 14(2); pl. 4, fig. 10.

1995 *Sciponoceras roto* Ciesliński, 1959; Wright & Kennedy, p. 315, text-figs 131j-l, n; pl. 94, figs 3-19; pl. 95, fig. 4; pl. 98, fig. 28 (with full synonymy).

1996 *Sciponoceras roto* Ciesliński, 1959; Kennedy in Gale et al., p. 580, figs 23a-d, j, k.

1998 *Sciponoceras roto* Ciesliński, 1959; Kaplan et al., p. 186, pl. 13, figs 9, 10.

Types

Ciesliński (1959) based this species nine syntypes from the Cenomanian of Poland.

Material

IRScNB 11477, from the Tourtia de Tournai of Tournai, Hainaut, and IRScNB 11480, from the Tourtia de Tournai of Carrière du Cornet, Chercq, near Tournai, Hainaut.

Description

IRScNB 11480 are tiny fragments of internal moulds of phragmone with a subcircular whorl section and a maximum preserved whorl height of 5 mm. The larger specimen consists of three camerae, and is smooth apart from a single constriction. IRScNB 11477 is a 27 mm long fragment retaining replaced, limonite-stained shell. The whorl section is circular, with a maximum preserved whorl height of 7.2 mm. The surface of the shell is smooth but for a prominent constriction that is transverse and weak on the dorsum, weakly prosiradiate on the flanks, and crosses the venter in a broad convexity.

Discussion

Whorl section and wide spacing of constrictions show these fragments to be *Sci. roto*.

Occurrence

In addition to the present records, the species is known from Westfalen (Germany), southern England, France, Tunisia, Kazakhstan, South Africa and Madagascar. This is an Early Cenomanian species where well dated, but may range into the lower Middle Cenomanian. It is said to range throughout the Cenomanian in Poland (Marcinowski, 1980, p. 254).

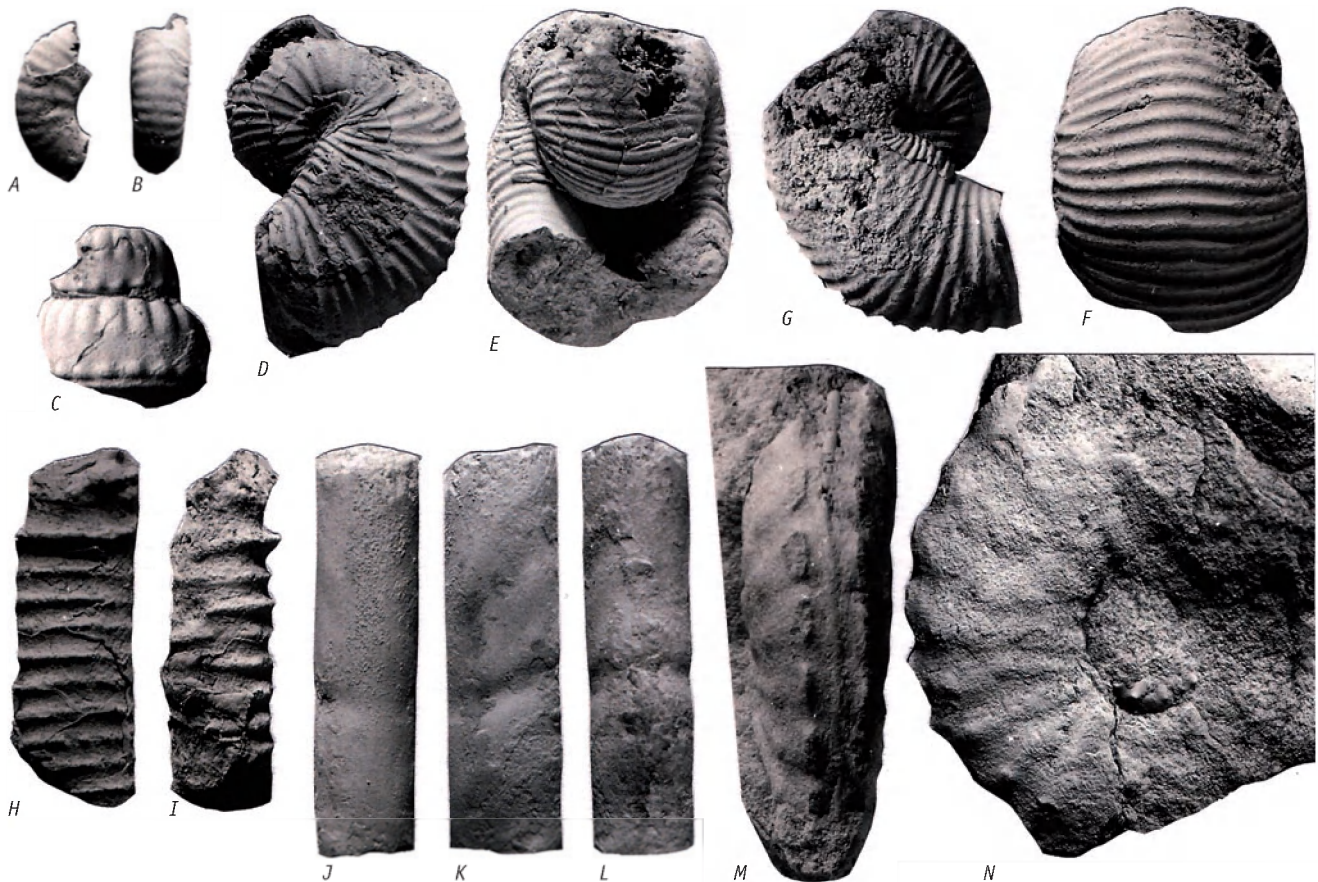


Fig. 19A, B. *Scaphites* sp., IRScNB 11473, Tourtia of Montignies-sur-Roc, Hainaut; C. *Mesoturrilites corrugatus* Wright & Kennedy, 1996, IRScNB 11474, Tourtia de Tournai, Tournai (Hainaut); D-G. *Scaphites obliquus* J. Sowerby, 1813, IRScNB 11475, Tourtia de Tournai, Tournai, Hainaut; H, I. *Hamites simplex* d'Orbigny, 1842, IRScNB 11476, Tourtia de Tournai, Tournai (Hainaut); J-L. *Sciponoceras roto* Ciesliński, 1959, IRScNB 11477, Tourtia de Tournai, Tournai (Hainaut); M, N. *Acompsoceras inconstans* (Schlüter, 1871), IRScNB 11478, Meule de Bernissart, Onnaing-les-Valenciennes (Nord, France). Figures A-L are x2; M-N are x1.

Superfamily Scaphitoidea Gill, 1871

Family Scaphitidae Gill, 1871

Subfamily Scaphitinae Gill, 1871

Genus Scaphites Parkinson, 1811

Type species

Scaphites equalis J. Sowerby, 1813, p. 53, pl. 18, figs 1-3, by the subsequent designation of Meek (1876, p. 413).

Scaphites obliquus J. Sowerby, 1813

Fig. 19D-G.

1813 *Scaphites obliquus* J. Sowerby, p. 54, pl. 18, figs 4-7.

1996 *Scaphites obliquus* J. Sowerby, 1813; Wright & Kennedy, p. 390, pl. 114, figs 7-20; pl. 115, figs 1-17; pl. 116, fig. 6; text-fig. 150f, k (with full synonymy).

1998 *Scaphites obliquus* J. Sowerby, 1813; Kaplan et al., p. 223, pl. 13, figs 11, 12; pl. 60, fig. 3; pl. 66, figs 1-7, 9, 10.

Type

The lectotype is BMNH 43987a from the Lower Chalk of Hamsey (Sussex, England), the original of J. Sowerby (1813, p. 54, pl. 18, figs 4-6), designated by Kennedy (1971, p. 33) and reillustrated by Wright & Kennedy (1996, pl. 114, fig. 18).

Material

IRScNB 11475, from the Tourtia de Tournai of Tournai, Hainaut.

Description

The specimen is limonitised and retains limonitic shell. It consists of a phragmocone, 15 mm in diameter, and the adapical part of the body chamber shaft of a macroconch. The coiling of the phragmocone is very involute, the umbilicus largely concealed by the umbilical margin of the succeeding shaft; the whorl section is depressed reniform. Crowded narrow sharp ribs are straight and rursiradiate on the inner flanks. They branch on the flank and additional ribs intercalate; the ribs are transverse to feebly concave across the venter. The adapical section of the body chamber has a very depressed, reniform cross section, with a whorl breadth to height ratio of 1.6. There is a bulge on the umbilical seam that partially conceals the umbilicus of the spire. Adaperturally of this, the umbilical wall is broadly convex. Sharp, narrow, crowded ribs become increasingly prorsiradiate adaperturally; they are straight on the inner flank and increase by branching and intercalation, convex on the ventrolateral shoulder, initially concave at mid-venter but becoming transverse on the adapertural ribs.

Discussion

Scaphites obliquus co-occurs with *Sc. equalis* J. Sowerby, 1813 over part of its range. They differ in the development of few coarse distant primary ribs on the flanks of the latter (see

revision in Wright & Kennedy, 1996, p. 394, text-figs 153 (*pars*), 154 c, d; pl. 116, figs 1-5, 7-11; pl. 117, figs 1-11; pl. 118, figs 1-13).

Occurrence

Scaphites obliquus ranges from the base of the *Hypoturrilites carcitanese* Subzone of the Lower Cenomanian *Mantelliceras mantelli* Zone to the lower Upper Cenomanian *Calycocheras guerangeri* Zone. The geographic distribution extends from southern England to Belgium (the present record), Westfalen (Germany), France, Switzerland, Ukraine, Russia, Turkmenistan, Iran, Algeria and Tunisia, southern India and perhaps Madagascar.

Scaphites sp.

Fig. 19A, B.

Material

IRScNB 11473, from the Tourtia of Montignies-sur-Roc, Hainaut.

Description and discussion

This tiny fragment of a 120° sector of phragmocone has a maximum preserved whorl height of 4.6 mm. The whorl breadth to height ratio is around 1. The umbilical wall and shoulder are quite narrowly rounded. The flanks are feebly convex, the ventrolateral shoulders broadly rounded, the venter very feebly convex. Five relatively coarse primary ribs arise on the umbilical wall and are straight and feebly prorsiradiate on the inner flank. Most bifurcate around mid-flank, to give a total of 14 ribs at the ventrolateral shoulder, the secondary ribs feebly concave on the outer flanks and ventrolateral shoulders, and straight or feebly convex over the venter. The suture is only moderately incised, with a broad, asymmetrically bifid E/A, narrower bifid A.

Occurrence

As for material.



Fig. 20. *Turrilites acutus* Passy, 1832, NHMW 1857 XX 6, Tourtia de Tournai, Tournai (Hainaut), × 2.

Conclusions

In the first place, the present study of ammonites preserved in the IRScNB collections confirms the stratigraphic attribution of the various tourtias which Amédéo & Robaszynski (2010) recognised. Their sequence-stratigraphic interpretation of the tourtias (see Fig. 8) envisages a succession of third-order transgressive intervals which expressed themselves on the western margin of the Paris Basin up to the Mons Basin, by glauconitic microconglomeratic facies, or tourtias. These transgressive intervals are linked both to sea level drops and rapid sea level rises and covered increasingly larger areas during the great transgression of the Chalk sea. Each transgressive pulse is underlined by increasingly younger tourtias, to which names of different localities have been given.

Secondly, novelties reside in the punctuated presence, here and there, of outliers of Lower Cenomanian strata into the Mons Basin and beyond. The presence of *Mantelliceras dixonii* at Sassegny, as well as of the typically late Early Cenomanian (*Mantelliceras dixonii* Zone) *Acompsoceras inconstans* and *A. renevieri* at Hautrage, Onnain and Sassegny, suggest that, by extension, the remains of Lower Cenomanian which cannot be dated with more precision at Tournai and Bettrechies may also be of comparable age, i.e., *Mantelliceras dixonii* Zone.

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