

# Uppermost Cenomanian ammonites from Eure, Haute-Normandie, northwest France

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## ABSTRACT:

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Temporary exposures of chalks spanning the Cenomanian – Turonian boundary to the east of Brionne, Eure, Haute-Normandie, France, yielded well-preserved ammonite faunas. The *Metoicoceras geslinianum* Zone assemblage is: *Pseudocalycoceras angolaense* (SPATH, 1931), *Sumitomoceras cautisalbae* (WRIGHT & KENNEDY, 1981), *Calycoceras* (*Calycoceras*) sp. juv., *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896), *Euomphaloceras septemseriatum* (CRAGIN, 1893), *Metoicoceras geslinianum* (D'ORBIGNY, 1850), *Hamites cimarronensis* (KAUFFMAN & POWELL, 1977), *Allocrioceras annulatum* (SHUMARD, 1860), and *Sciponoceras gracile* (SHUMARD, 1860). The succeeding *Neocardioceras juddii* Zone assemblage is: *Thomelites serotinus* WRIGHT & KENNEDY, 1981, *Neocardioceras juddii juddii* (BARROIS & GUERNE, 1878), *Neocardioceras juddii barroisi* WRIGHT & KENNEDY, 1981, and *Thomasites gongilensis* (WOODS, 1911). Imprecisely localised are *Pachydesmoceras* sp., and *Nigericeras* aff. *scotti* COBBAN, 1972.

The majority of the species are new for northern France, and confirm the northwards extension of typically Tethyan taxa (*Thomasites*, *Nigericeras*) into the Boreal region during the uppermost Cenomanian, and previously recognized in southern England, as well as the occurrence of cosmopolitan acanthoceratids well-known at this level in the United States (*Pseudocalycoceras*, *Sumitomoceras*).

**Key words:** Ammonites, Cenomanian, Turonian, Cretaceous, France.

## INTRODUCTION

In the west of the Paris Basin, in the Roumois region between the valleys of the Seine and Risle (Text-fig. 1) exposures of Cenomanian and Turonian chalks were documented by JUIGNET (1974). Since that account, a temporary exposure at the now obscured Trou Tassin quarry on the plateau east of the Risle, close to Neuville-du-Bosc (Eure) exposed some tens of metres of chalk during the 1980's, exploited for agricultural purposes. One of us (J.G.) collected a suite of well-preserved ammonites from the upper part of the section, which demonstrated the presence of the upper-

most Cenomanian zones of *Metoicoceras geslinianum* and *Neocardioceras juddii*, the latter not previously recognized in the chalks of northwestern France. Many of the species present are new to the region, and include a range of Tethyan and cosmopolitan taxa.

## STRATIGRAPHY

The sequence across the Cenomanian-Turonian boundary interval is shown in Text-fig. 2. The section compares well with that exposed in the cliffs of Haute-Normandie at St-Jouin-Bruneval, Antifer-Le Tilleul,

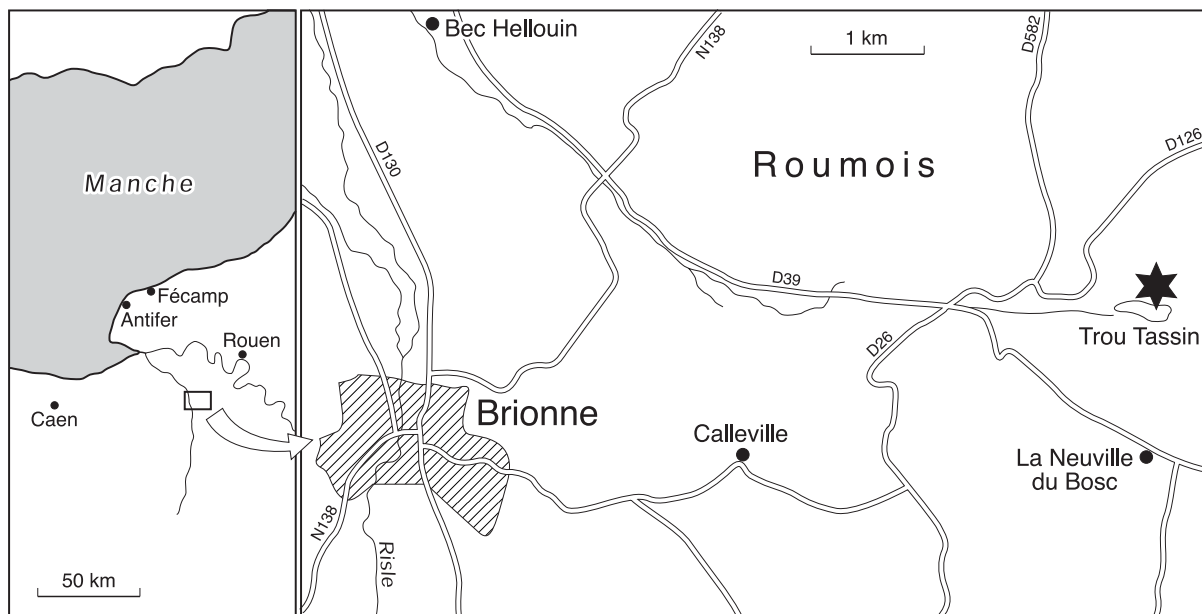


Fig. 1 Locality map for the Brionne area, Eure, Haute-Normandie, France, showing the position of the Trou Tassin Quarry

and Fécamp (JUIGNET & BRETON 1994). From bottom to top, the sequence is as follows.

1. Craie de Rouen (2 m exposed): bioturbated chalk with a line of black flints. The sequence passes up into a nodular chalk, terminated by a glauconitized hardground, equivalent to the hardgrounds Antifer 1 and 2 of the regional reference sections.

2. Craie d'Antifer (60 cm): bioturbated chalk with nodules and glauconitized pebbles resting on the top surface of the underlying hardground. The unit is terminated by a hardground that can be correlated with the regional Antifer 3 hardground. This unit yields the *Metoicoceras geslinianum* Zone fauna documented below.

3. Craie du Cap Fagnet (5.8 m): bioturbated chalks with nodular horizons and incipient hardgrounds, notably in the upper part, the latter equivalent to the regional Fagnet Hardground. Lines of small black flints occur in the upper part. The sparsely nodular chalks in the lowest part of the sequence yielded the *Neocardioceras juddii* Zone ammonites described below.

4. Craie du Val St-Nicolas (1 m exposed): chalks with scattered nodules, common inoceramid debris, and a course of black flints.

#### THE AMMONITE FAUNAS

The ammonite zonal sequence across the Cenomanian-Turonian boundary recognized at Pueblo, Colorado, the candidate Global Boundary Stratotype

Section for the base of the Turonian stage is shown in Text-fig. 3, as is that recognized in Southern England (WRIGHT & KENNEDY 1981, 1984). The definition of the base of the Turonian Stage adopted here follows that provisionally adopted by the Turonian Working Group of the Subcommittee on Cretaceous Stratigraphy at its meetings during the Second International Symposium on Cretaceous Stage Boundaries held in Brussels from September 8-16, 1995 (BENGTSON 1996): the first occurrence of the ammonite *Watinoceras coloradoense* WRIGHT & KENNEDY, 1981, at the base of Bed 86 of the Pueblo section.

The fauna from the Craie d'Antifer is as follows, and can be referred to the western European *Metoicoceras geslinianum* Zone and the coeval United States Western Interior *Sciponoceras gracile* Zone:

*Pseudocalycoceras angolaense* (SPATH, 1931), *Sumitomoceras cautisalbae* (WRIGHT & KENNEDY, 1981), *Sumitomoceras cf. conlini* (WRIGHT & KENNEDY, 1981), *Calycoceras (Calycoceras) sp. juv.*, *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896), *Euomphaloceras septemseriatum* (CRAGIN, 1893), *Metoicoceras geslinianum* (D'ORBIGNY, 1850), *Hamites cimarronensis* KAUFFMAN & POWELL, 1977, *Allocioceras annulatum* (SHUMARD, 1860), and *Sciponoceras gracile* (SHUMARD, 1860). Elements of this fauna occur widely in Europe, and all but *S. cautisalbae* occur in the U.S. Gulf Coast and Western Interior, providing an excellent basis for intercontinental correlation.

The ammonites from the basal part of the Craie du Cap Fagnet can be referred to the *Neocardioceras juddii*

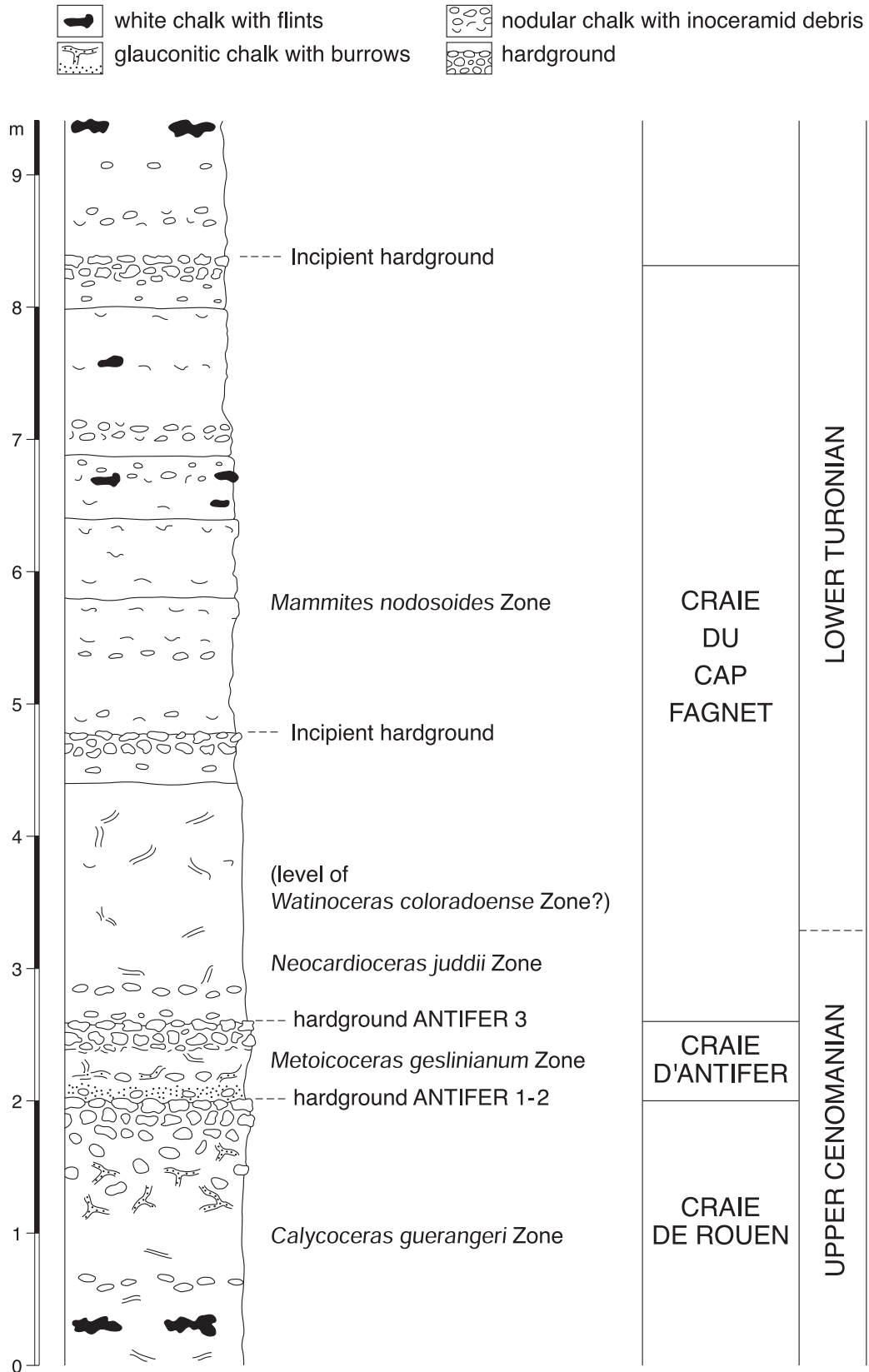


Fig. 2. The Cenomanian-Turonian boundary interval at the Trou Tassin Quarry, Eure, Haute-Normandie, France

SUBSTAGE	PUEBLO	S. ENGLAND
LOWER TURONIAN	<i>Mammites nodosoides</i> <i>Vascoceras birchbyi</i> <i>Pseudaspidoceras flexuosum</i> <i>Watinoceras devonense</i>	<i>Mammites nodosoides</i> <i>Watinoceras devonense</i>
UPPER CENOMANIAN (part)	<i>Neocardioceras juddii</i> ( <i>Nigericeras scotti</i> ) <i>Sciponoceras gracile</i>	<i>Neocardioceras juddii</i> <i>Metoicoceras geslinianum</i>

Fig. 3. The ammonite zonal sequence across the Cenomanian-Turonian boundary recognised at Pueblo, Colorado, candidate Global Stratotype section for the base of the Turonian Stage, and in southern England

Zone: *N. juddii juddii* (BARROIS & GUERNE, 1878), *N. juddii barroisi* WRIGHT & KENNEDY 1981, and *Thomasites gongilensis* (WOODS, 1911). Of particular interest is the occurrence of *Thomasites*, a typically Tethyan genus of the uppermost Cenomanian and Lower Turonian (CHANCELLOR & *al.* 1994) which spread northwards during the latest Cenomanian, and is frequent in the *juddii* Zone in southern England (WRIGHT & KENNEDY 1981), and in the northern Aquitaine (Port-des-Barques, south of La Rochelle, Charente-Maritime: Oxford University Museum of Natural History Collections).

The record of *Nigericeras* aff. *scotti* COBBAN, 1971, is based on a specimen found loose. *N. scotti* characterizes a narrow interval between the upper Cenomanian *juddii* Zone and the basal Turonian *Watinoceras coloradoense* Zone in the U.S. Western Interior (COBBAN & SCOTT 1973), and we presume it to be derived from the lower part of the Craie du Cap Fagnet; it too is an immigrant, for *Nigericeras* is a common element in Tethyan Upper Cenomanian faunas (e.g. MEISTER & *al.* 1992).

We have seen no ammonite evidence for the lowest Turonian *Watinoceras devonense* Zone in the faunas from the Craie du Cap Fagnet of Trou Tassin, but correlative sections on the coast yield ammonites of the Lower Turonian *Mammites nodosoides* Zone some metres above the base of the unit.

The uppermost Cenomanian faunas from Haute Normandie agree closely with those known from elsewhere in the Anglo-Paris Basin (southern England, Boulonnais, Aube), Provence and Germany. They are particularly characterised by the appearance of a range of taxa that had been previously restricted to the U.S. Western Interior and Gulf Coast regions, as well as some Tethyan incursors. This mingling of faunas is a response to the rising sea levels at the time leading to free, open water links. In particular, during the period

immediately prior to the *Metoicoceras geslinianum* Zone (*Calycoceras guerangeri* Zone in Europe, *Metoicoceras mosbyense*/*Dunveganoceras pondi* Zone in the U.S. Western Interior) we see European incursions into the Interior, with *Protacanthoceras proteus* WRIGHT & KENNEDY, 1987, known from the Black Hills in the Northern Interior and *Calycoceras* (*Proeucalycoceras*) *guerangeri* (SPATH, 1926), *Eucalycoceras pentagonum*, *Euomphaloceras euomphalum* (SHARPE, 1855), and *Vascoceras diartianum* (D'ORBIGNY, 1850) in New Mexico (KENNEDY & *al.* 1996; COBBAN & *al.* 1989).

Following this, *Metoicoceras* and *Neocardioceras*, present in the Western Interior in the lower Upper Cenomanian spread to Europe and elsewhere. As well as this interchange there are other common taxa, notably species of *Sciponoceras* and *Euomphaloceras* that occur in both Europe, the Western Interior and much of the rest of the world at this time.

*Thomasites*, common on the south side of Tethys in the Upper Cenomanian of Nigeria other parts of West Africa spread northwards into the Anglo-Paris Basin and the Southern Interior for a brief interval in the *juddii* Zone and immediately prior to this.

## CONVENTIONS

Location of specimens: The following abbreviations are used to indicate the location of specimens mentioned in the text:

BMNH: British Museum (Natural History), London  
BGS: British Geological Survey, Keyworth  
JG: Jerome Girard Collection, Museum d'Histoire Naturelle, Le Havre  
OUM: University Museum of Natural History, Oxford  
SM: Sedgwick Museum, Cambridge

USNM: National Museum of Natural History, Washington DC.

TMM: University of Texas Memorial Museum, Austin, Texas.

The suture terminology is that of WEDEKIND (1916) as applied by KULLMANN & WIEDMANN (1970). E = external lobe, L = lateral lobe, U = umbilical lobe, I = internal lobe.

#### SYSTEMATIC PALAEOLOGY

Order Ammonoidea ZITTEL, 1884  
 Suborder Ammonitina HYATT, 1889  
 Superfamily Desmocerataceae ZITTEL, 1895  
 Family Desmoceratidae ZITTEL, 1895  
 Subfamily Puzosiinae SPATH, 1922  
 Genus *Pachydesmoceras* SPATH, 1922

TYPE SPECIES: *Ammonites denisonianus* STOLICZKA (1865, p.133, pl. 65, fig. 4; pl. 66, pl. 66a), by original designation.

*Pachydesmoceras* sp.  
 (Pl. 2, Figs 5, 6)

MATERIAL: A single fragment, JG43.

DESCRIPTION AND DISCUSSION: This small fragment is only 48 mm long, and preserves the venter and outer flank of a compressed ammonite with flattened flanks and broadly rounded venter. Ornament consists of coarse, blunt, distant ribs that are markedly concave on the outer flank and ventrolateral shoulder and cross the venter in a broad convexity. Of the nine ribs partially preserved four extend well down the outer flank and three are confined to the ventrolateral shoulder and venter. Two interspaces are deepened and constriction-like.

The style of ornament is clearly that of Desmoceratidae, comparing most closely with the Upper Albian to Upper Turonian genus *Pachydesmoceras* SPATH, 1922. This genus is well known from the Lower Turonian of the Corbières in southern France, and our specimen is similar to specimens of *Pachydesmoceras linderi* (DE GROSSOUVRE, 1894) from near Padern, Aude (e.g. OUM KZ15735). This genus has not been previously recorded from northern France.

OCCURRENCE: Upper Cenomanian, collected loose, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

Superfamily Acanthocerataceae DE GROSSOUVRE, 1894  
 Family Acanthoceratidae DE GROSSOUVRE, 1894  
 Subfamily Acanthoceratinae DE GROSSOUVRE, 1894  
 Genus *Pseudocalycoceras* THOMEL, 1969

TYPE SPECIES: By original designation by THOMEL (1969, p. 650): *Ammonites harpax* STOLICZKA (1864, p.72 pars, pl.39, fig. 1 only).

*Pseudocalycoceras angolaense* (SPATH, 1931)  
 (Pl.1, Figs 1-6)

1927. *Acanthoceras* sp. A. MOREMAN, p. 95, pl. 15, fig. 2.  
 1931. *Protacanthoceras angolaense* SPATH, p. 316.  
 1942. *Eucalycoceras dentonense* MOREMAN, p.205, pl. 33, figs 4, 5; text-fig. 2k.  
 1942. *Eucalycoceras indianense* MOREMAN, p. 206, pl. 33, figs 9, 10; text-fig. 21.  
 1942. *Eucalycoceras lewisvillense* MOREMAN, p. 206, pl. 33, figs 6, 7; text-figs 2n, u.  
 1988. *Pseudocalycoceras angolaense* (SPATH, 1931); KENNEDY, p. 42, pl. 4; figs 1, 2, 6-9; 11, 12; pl. 5, figs 1-12, pl. 8, figs 7, 8; pl. 22, figs 8, 9; text-figs 10H, 11B, E.  
 1989. *Pseudocalycoceras angolaense* (SPATH, 1931); COBBAN & al., p. 29, figs 29, 73e-o, 74a-g (with full synonymy).  
 1989. *Pseudocalycoceras angolaense* (SPATH, 1931); KENNEDY & al., p. 58, figs 7a, b, j.  
 1994. *Pseudocalycoceras angolaense* (SPATH, 1931); KENNEDY & JUIGNET, p. 489, fig. 13b.  
 1996. *Pseudocalycoceras angolaense* (SPATH, 1931); KIRKLAND, p. 80, pl. 10, figs C-E; pl. 16, figs F-H, K.

LECTOTYPE: Designated by KENNEDY (1988, p. 42) the original of DOUVILLÉ (1931, p. 17, pl. 1, fig. 1, from the Upper Cenomanian of Salinas, Angola. This is not the holotype as indicated by COOPER (1978), because SPATH specifically refers to a second specimen, which is a paralectotype of the species.

MATERIAL: Seven specimens, JG10, 23, 27, 28, 30, 34, 58, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION AND DISCUSSION: COBBAN & SCOTT (1973), WRIGHT & KENNEDY (1981) and KENNEDY (1988) provide detailed accounts of this species, not previously known from Haute Normandie. The present material varies from juvenile fragments with a whorl height of only 9 mm (no. 28; Pl. 1, Figs 3-4) to a near-complete but poorly preserved adult (no. 58), 92 mm in diameter. During early and middle growth, coiling is moderately

evolute, with  $U = 31\%$  of diameter, of moderate depth, with a flattened subvertical wall. The whorl section varies from compressed to depressed, with the greatest breadth just outside the umbilical shoulder intercostally and at the umbilical bulla in costal section; the latter has converging sides and a polygonal ventrolateral and ventral region. There are 16-22 ribs per half whorl. The ribs arise singly or in pairs from 5 prominent umbilical bullae, or intercalate low on the flank. They are coarse and blunt, straight or feebly flexed, and rursiradiate to feebly rectiradiate. All have well-developed inner and outer ventrolateral and siphonal clavi. This type of ornament extends onto the early part of the adult body chamber (Pl. 1, Figs 5, 6), beyond which the tubercles decline progressively and the venter becomes rounded. Sutures not seen.

Differences from other species are discussed by WRIGHT & KENNEDY (1981, p. 37).

**OCCURRENCE:** Upper Cenomanian, *Metoicoceras geslinianum* Zone and correlatives in north-central and west Texas, New Mexico, Arizona, Colorado, Kansas and Utah in the USA, southern England, Haute Normandie and Charente-Maritime in France. Records from Lebanon (BASSE 1940, p. 448, pl. 6, fig. 3) and Israel (AVNIMELECH & SHORESH 1962, p. 531) are of a significantly older species of *Pseudocalycoceras*.

#### Genus *Sumitomoceras* MATSUMOTO, 1969

**TYPE SPECIES:** By original designation: *Sumitomoceras faustum* MATSUMOTO & MURAMOTO (1969, p. 283, pl. 38, figs 1-4; text-fig. 8).

**DISCUSSION:** *Sumitomoceras* and *Tarrantoceras* were treated as synonyms by COOPER (1978, p. 93). They differ in the earlier loss or absence of siphonal tubercles in *Sumitomoceras*, development of constriction-like deepened interspaces in some species and rounded venter in middle and later growth (see also WRIGHT & KENNEDY 1981, p. 38).

**OCCURRENCE:** Upper Cenomanian *Metoicoceras geslinianum* Zone and correlatives in north-east and west Texas, New Mexico and Colorado in the USA, southern England, Haute Normandie in France, and Japan.

*Sumitomoceras cautisalbae* (WRIGHT & KENNEDY, 1981) (Pl. 1, Figs 19, 20; Pl. 2, Figs 1, 2, 7, 8, 24, 25)

1981. *Tarrantoceras* (*Sumitomoceras*) *cautisalbae* WRIGHT & KENNEDY, p. 39, pl. 6, figs 1, 2, 4?, 5?

**TYPE:** Holotype is OUM K33359, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of Bed C of the Cenomanian Limestone at White Cliff, Seaton, Devon.

**MATERIAL:** JG. 06, 11, 15, 26, 55 and 56, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

**DESCRIPTION AND DISCUSSION:** All specimens are fragments only. Nos. 55 and 06 (Pl. 1, Figs 19, 20; Pl. 2, Figs 24, 25) show the inner whorls. Coiling is evolute with a shallow umbilicus, a flattened subvertical umbilical wall, narrowly rounded umbilical shoulder, flattened, subparallel sides and broadly rounded ventrolateral shoulders and venter. There are up to 16 ribs per half whorl. They arise in pairs or sometimes singly from sharp bullae that project into the umbilicus, while intercalated ribs arise low on the flank or extend to the umbilical shoulder as mere striae. The ribs are feebly flexuous and prorsiradiate on the flanks, and all bear bullate to feebly clavate inner ventrolateral tubercles. A coarsening rib sweeps forwards to feebly clavate outer ventrolateral tubercles and a blunt, transverse or feebly convex rib crosses the venter; there are no siphonal tubercles. Larger fragments with whorl heights of up to 15 mm show essentially similar ornament (Pl. 2, Figs 1, 2, 7, 8), the outer ventrolateral tubercles weakening markedly in relation to the inner. Some interspaces are deepened and constriction-like, and there are occasional feeble, non-tuberculate ventral ribs (Pl. 2, Fig. 8).

*Sumitomoceras cautisalbae* most closely resembles *Sumitomoceras faustum* MATSUMOTO & MURAMOTO (1969, p. 283, pl. 38, figs 1-4), but has lower whorls, a more broadly rounded venter, less flexuous ribs, more persistent ventrolateral tubercles and stronger constrictions. Other species are discussed by KENNEDY (1988).

**OCCURRENCE:** Upper Cenomanian *Metoicoceras geslinianum* Zone of Devon, England, and Haute Normandie, France.

*Sumitomoceras* cf. *conlini* (WRIGHT & KENNEDY, 1981) (Pl. 2, Figs 11, 12)

compare:

1981. *Tarrantoceras* (*Sumitomoceras*) *conlini* WRIGHT & KENNEDY, p. 39, text-fig. 16A.

1988. *Tarrantoceras* (*Sumitomoceras*) *conlini* WRIGHT & KENNEDY; KENNEDY, p. 44, pl. 6, figs 1-5, 8-13, 16, 17, text-fig. 10B.

1989. *Sumitomoceras conlini* WRIGHT & KENNEDY, 1981; COBBAN & *al.*, p. 31, figs 31, 72a-j.  
 1996. *Sumitomoceras conlini* WRIGHT & KENNEDY, 1981; KIRKLAND, p. 81, pl. 16, figs D, E.

HOLOTYPE: By monotypy: USNM 400803, from the Britton Formation, Upper Cenomanian *Sciponoceras gracile* Zone, of Ellis County, Texas.

MATERIAL: JG 88 from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION AND DISCUSSION: This well-preserved body chamber fragment has a maximum whorl height of 23.5 mm and a whorl breadth to height ratio of 0.83. The inner flanks are broadly rounded, the outer flanks convergent, the ventrolateral shoulders broadly rounded and the broad venter somewhat flattened. Primary ribs arise at the umbilical seam, are feebly prorsiradiate and feebly flexuous on the flank, which they cross without developing bullae. They flex forwards and strengthen over the ventrolateral shoulder, passing straight across the venter without developing any trace of tubercles.

The fragment differs from the holotype of *S. conlini* only by the absence of umbilical bullae, which lack may merely reflect proximity to the adult aperture.

OCCURRENCE: *S. conlini* was previously known only from the *Sciponoceras gracile* Zone (the correlative of the *Metoicoceras geslinianum* Zone) of southern Texas, northeastern Arizona and southwestern New Mexico.

Genus *Calycoceras* HYATT, 1900  
(ICZN Generic Name No.1352)

TYPE SPECIES: By designation under the Plenary Powers (ICZN Opinion No. 557) *Ammonites navicularis* MANTELL (1822, p. 198, pl. 22, fig. 5) (ICZN Specific Name No. 1633).

Subgenus *Calycoceras* (*Calycoceras*) HYATT, 1900  
*Calycoceras* (*Calycoceras*) sp. juv.  
(Pl. 2, Figs 16, 17)

?1981. *Calycoceras* (*Lotzeitis*) (?) sp. KENNEDY & JUIGNET, p. 32, fig. 7a-c.

MATERIAL: JG 89, from the Upper Cenomanian

*Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION AND DISCUSSION: The specimen is a juvenile, only 26.5 mm in diameter. The coiling appears to have been fairly evolute, with a depressed reniform intercostal whorl section, the costal section with the greatest breadth at the umbilical bullae, the sides feebly concave and the venter very broad and rounded. There are six strong umbilical bullae per half whorl. These give rise to strong, coarse, straight, prorsiradiate primary ribs, which bear strong inner ventrolateral and weak outer ventrolateral and siphonal tubercles at the smallest diameter visible, borne on a broad transverse ventrolateral and ventral rib. These are separated by single shorter intercalated ribs which arise low on the flank, lack inner ventrolateral tubercles but otherwise resemble the primary ribs in their ventral development. There are occasional very weak, nontuberculate intercalated ribs. On the last half whorl the outer ventrolateral and siphonal tubercles disappear. The site of the inner ventrolaterals is damaged; and their development cannot be determined.

OCCURRENCE: As under material.

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

TYPE SPECIES: By original designation: *Ammonites pentagonus* JUKES-BROWNE (1896, p. 156, pl. 5, fig. 1) (ICZN Specific Name no. 1635).

*Eucalycoceras pentagonum* (JUKES-BROWNE, 1896)  
(Pl. 1, Figs 14, 15; Pl. 2, Figs 3, 4)

1896. *Ammonites pentagonus* JUKES-BROWNE, p. 156, pl. 5, fig. 1.  
 1989. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); COBBAN & *al.*, p. 27, figs 28, 73a-d.  
 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).  
 1994. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); KENNEDY, p. 230, pl. 11, figs 6, 7.  
 1994. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); KENNEDY & JUIGNET, p. 485, figs 13c, d.  
 1994. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); ROBASZYNSKI & *al.*, p. 413, pl. 15, figs 4, 5, 9.  
 1996. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); AMÉDRO & *al.*, p. 203, fig. 11.

1996. *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896);  
WILMSEN & WIESE, p. 94, pl. 1, fig. 2.

TYPE: The holotype by monotypy is BGS.GSM 53481 from the remanié phosphatic Upper Cenomanian *C. guerangeri* Zone fauna of Bed C of the Cenomanian Limestone at Humble Point, Devon.

MATERIAL: JG 05 and 29, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: Specimen 29 (Pl. 2, Figs 3, 4) is a somewhat crushed individual 53 mm in diameter. Coiling is fairly involute. The whole section is compressed with flattened inner flanks, convergent outer flanks and an arched venter. Primary ribs arise on the umbilical wall and strengthen into sharp crowded umbilical bullae. These give rise to straight prorsiradiate primary ribs, either singly or in pairs, while one or two intercalated ribs arise both low and high on the flank. Ribbing is dense and crowded, all ribs strengthen on the outer flank and bear conical inner and clavate outer ventrolateral and siphonal tubercles on the arched venter, which is markedly polygonal in the costal section. The larger fragment (Pl. 1, Figs 14, 15) is part of a body chamber and shows distinctive broad, flat-topped ribs separated by narrow interspaces; there are no tubercles. Sutures not seen.

DISCUSSION: *E. pentagonum* has not been previously recorded in Haute Normandie. The body chamber characteristics of this species are highly distinctive. *Eucalycoceras rowei* (SPATH, 1926a, p. 431; see WRIGHT & KENNEDY 1990, p. 280, pl. 76, figs 2, 3; pl. 77, figs 2-10; pl. 78, fig. 2; text-figs 89C, 107F, J; 125A, B) is a smaller, more compressed species with weak or no inner ventrolateral tubercles, lacking flat-topped ribs on the body chamber. *E. gothicum* (KOSSMAT 1985, p. 198(102), pl. 25(1), fig. 3; WRIGHT & KENNEDY 1990, p. 279, pl. 76, figs 1, 3, 4, 6; text-fig. 94I-K) has fewer, less regular ribs and tubercles with large umbilical bullae that project much further out into the umbilicus than the corresponding tubercles in *E. pentagonum*.

OCCURRENCE: *E. pentagonum* first appears in the phosphatic remanié Upper Cenomanian *C. guerangeri* Zone fauna of Bed C of the Cenomanian Limestone on the Devon Coast and inland at Shapwick and Wilmington in Devon, England. It also occurs in the Upper Cenomanian *C. guerangeri* Zone Lower Chalk at Eastbourne, Sussex, England. It is known at a similar horizon in the Basses-Alpes (THOMEL'S Zone 6) and

Cassis, Bouches-du-Rhone, France, Spain and Portugal, Roumania, Tunisia, and Tinrhert in the western Sahara, Madagascar, southern India, Tadjikistan and Japan. It also occurs in the Upper Cenomanian *M. geslinianum* Zone in Haute-Normandie, in the Sables à *Catopygus obtusus* of Sarthe, and in Alpes-Maritimes in France, and in the correlative *Sciponoceras gracile* Zone in South Dakota, Colorado and southwestern New Mexico in the USA.

#### Genus *Thomelites* WRIGHT & KENNEDY, 1973

TYPE SPECIES: By original designation *Jeanrogericeras sornayi* THOMEL (1966, p. 431, pl.11, figs 1-3).

#### *Thomelites serotinus* WRIGHT & KENNEDY, 1981 (Pl. 4, Figs 6-8; Pl. 5, Figs 5, 6)

1978. *Watinoceras coloradoense* HENDERSON; KENNEDY & HANCOCK, pl. 15, fig. 4.

1981. *Thomelites serotinus* WRIGHT & KENNEDY, p. 40, pl. 8, figs 7-9, 16; pl. 10, fig. 19; text-figs 19M, 0, R.

HOLOTYPE: BMNH C82215, from the *Neocardioceras* Pebble Bed, Upper Cenomanian *N. juddii* Zone, Haven Cliff, Devon, England.

MATERIAL: Four specimens, JG. 11, 13, 21, 22, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: All specimens are badly preserved pebble fossils (e.g. Pl. 5, Figs 5, 6). The best, no.13 (Pl. 4, Figs 6-8) is 55.5 mm in diameter. Coiling is evolute, with  $U = 39\%$  of diameter, broad and of moderate depth, with a flattened, subvertical wall. The whorl section is slightly compressed, with flattened convergent sides, the venter rounded in intercostal section and polygonal in costal section. Primary ribs, ten per half whorl, arise on the umbilical wall and strengthen into prominent umbilical bullae that project into the umbilicus. They give rise to strong primary ribs either singly, or rarely in pairs, while some non-bullate ribs arise at the umbilical shoulder. Ribs are coarse, blunt and prorsiradiate, totalling 15 per half whorl. All bear prominent inner ventrolateral tubercles of variable strength and strong outer ventrolateral clavi. Ribs weaken markedly over the venter and there are long, low siphonal clavi.

Sutures not seen.



DISCUSSION: Evolute coiling, coarse ribbing and tuberculation show these specimens to be *Thomelites serotinus*, not previously recorded from Haute Normandie. This species most clearly resembles *T. hancocki* JUIGNET & KENNEDY (1976, p. 123, pl. 34, figs 2a-c) which is smaller, has fewer ribs, some of which are intercalatories, and much weaker bullae.

OCCURRENCE: Upper Cenomanian *Neocardioceras juddii* Zone of Devon and Sussex, England, and Haute Normandie, France.

Genus *Neocardioceras* SPATH, 1926

TYPE SPECIES: By original designation by SPATH (1926b, p. 81): *Ammonites juddii* BARROIS & GUERNE (1878, p. 46, pl. 1, figs 1, 2).

*Neocardioceras juddii juddii* (BARROIS & GUERNE, 1878)  
(Pl.1, Figs 9-11, 16-18)

1878. *Ammonites juddii* BARROIS & GUERNE, p. 46, pl. 1, figs 1, 2.
1981. *Neocardioceras juddii juddii* (BARROIS & GUERNE, 1878); WRIGHT & KENNEDY, p. 50, pl. 9, figs 1-3, 5-11; text-figs 17, 1, 2; 19, H, I (with full synonymy).
1981. *Neocardioceras juddii* (BARROIS & GUERNE); HOOK & COBBAN, p. 9, pl. 1, figs 6-8.
1986. *Neocardioceras juddii juddii* (BARROIS & GUERNE); KENNEDY, pl. 8, figs 1-3.
1989. *Neocardioceras juddii* (BARROIS & GUERNE, 1878); COBBAN & al., p. 31, figs 33, 75f-dd, ii, mm.
1989. *Neocardioceras juddii* (BARROIS & GUERNE, 1878); KENNEDY & al., p. 62, figs 8a-f.
- non 1991. *Neocardioceras juddii* BREITKREUTZ & al., p. 42, figs 3-5 (= *Watinoceras* sp.).
1994. *Neocardioceras juddii juddii* (BARROIS & GUERNE, 1878); KENNEDY & JUIGNET, p. 490, fig. 11e.
1996. *Neocardioceras juddii juddii* (BARROIS & GUERNE); KIRKLAND, p. 81, pl. 25, figs m, n, 1, r.
- non 1998. *Neocardioceras juddii* (BARROIS & GUERNE, 1878); KAPLAN & al., p. 170, pl. 58, fig. 11 (= *Watinoceras* sp.).
1999. *Neocardioceras juddii* (BARROIS & GUERNE, 1878); KENNEDY & al., p. 308, pl. 3, figs 8, 10.

TYPES: The originals of BARROIS & GUERNE (1878, pl. 1, figs 1, 2) are lost.

MATERIAL: Four specimens, JG 35, 37, 38, 50, from the Upper Cenomanian *Neocardioceras juddii* Zone

fauna of the lower part of the Craie du Cap Fagnet, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: Specimens are 13-27 mm in diameter. Coiling is quite involute with a small umbilicus of moderate depth comprising 28% of the diameter. There are 12 prominent umbilical bullae per whorl in the best-preserved specimen (Pl. 1, Fig. 11) which project out into the umbilicus. They give rise to groups of two or three primary ribs while there are intercalated ribs that may extend to the umbilical shoulder as mere striae, to give a total of 18 ribs per half whorl. The ribs are markedly flexuous and prorsiradiate, and bear sharp outer ventrolateral clavi. The ribs project forwards on the venter to form an acute chevron with a sharp siphonal clavus at the apex.

Sutures not seen.

DISCUSSION: *N. juddii* was not previously known from Haute Normandie. *N. juddii juddii* differs from *N. juddii barroisi* WRIGHT & KENNEDY (1981, p. 50, pl. 8, fig. 1; pl. 9, figs 4, 12-20; text-figs 19J, L) in its fine, sharp ribbing and tuberculation and more compressed whorl section.

OCCURRENCE: Upper Cenomanian *Neocardioceras juddii* Zone of Devon, England, Ardennes, Haute Normandie and Sarthe in France, the German Federal Republic, Trans-Pecos Texas, New Mexico, Arizona, Montana and north-central Wyoming in the USA.

*Neocardioceras juddii barroisi* WRIGHT & KENNEDY, 1981  
(Pl. 1, Figs 7, 8)

1981. *Neocardioceras juddii barroisi* WRIGHT & KENNEDY, p. 50, pl. 8, fig. 1; pl. 9, figs 4, 12-20; text-figs 19J, L (with additional synonymy).
1986. *Neocardioceras juddii barroisi* WRIGHT & KENNEDY; KENNEDY, pl. 8, figs 4, 5.

HOLOTYPE: BGS Zn 9147, the original of WRIGHT & KENNEDY (1981, pl. 9, fig. 16), from the Upper Cenomanian *Neocardioceras juddii* Zone fauna of the *Neocardioceras* Pebble Bed, Haven Cliff, Seaton, Devon, England.

MATERIAL: JG. 40, from the Upper Cenomanian *Neocardioceras juddii* Zone fauna of the lower part of the Craie du Cap Fagnet, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION AND DISCUSSION: *N. juddii barroisi* differs from the nominate subspecies by its coarser, blunter ribs, a less compressed whorl section and more obtuse ventral chevron. The single Haute Normandie specimen is only 19 mm in diameter, and has coarse, blunt, slightly flexuous ribs that are irregularly long and short, the long ribs arising singly or in pairs from umbilical bullae. There are feeble inner, and stronger outer ventrolateral clavi; the venter is abraded.

OCCURRENCE: Upper Cenomanian *Neocardioceras juddii* Zone, in Devon, England, Germany and Haute Normandie in France.

Genus *Nigericeras* SCHNEEGANS, 1943

TYPE SPECIES: *Nigericeras gignouxi* SCHNEEGANS (1943, p. 119, pl. 5, figs 10-15); by subsequent designation by REYMENT (1955, p. 62).

*Nigericeras* aff. *scotti* (COBBAN, 1972)  
(Pl. 2, Figs 26, 27; Pl. 4, Figs 1-3)

compare:

1972. *Nigericeras scotti* COBBAN, p. 18, pl. 9, figs 1-4; pl. 18, figs 1-9; text-figs 15-17.

HOLOTYPE: USNM 166396, from USGS Mesozoic locality D6756 in Baca County, Colorado, USA.

MATERIAL: Two specimens, JG. 23 and 25, Upper Cenomanian, collected loose, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: No. 25 is a fragment with a maximum whorl height of 9.3 mm (Pl. 2, Figs 26, 27). The costal whorl section is markedly polygonal, with a flat subvertical umbilical wall in intercostal section and narrowly rounded umbilical shoulder. Primary ribs arise at strong, sharp umbilical bullae that project into the umbilicus. The ribs are strong, high and prorsiradiate; each bears a sharp conical inner ventrolateral tubercle, from which a broadening rib sweeps forwards to a strong sharp outer ventrolateral clavus. One or two non-bullate ribs separate the bullate ones, arising in pairs from the umbilical shoulder and strengthening to match the main ribs on the outer flank and ventrolateral shoulder, where all ribs have equally developed tubercles. The ribs weaken markedly and are transverse over the venter, with a feeble siphonal clavus borne on a feeble, discontinuous siphonal ridge. No.23 is septate to 58 mm diameter. The

flanks and umbilical region are damaged (Pl. 4, Fig. 2), but at the smallest diameter visible the flanks seem to have been flat and subparallel with strong umbilical bullae. The pattern of flank ribbing cannot be determined, but there were progressively weakening conical inner ventrolateral tubercles, linked by a strong rib to persistent clavate outer ventrolaterals. The ribs decline on the venter, but there are weak siphonal clavi. The venter rounds progressively on the last half whorl of phragmocone, inner ventrolateral and siphonal tubercles disappear, followed by the outer ventrolaterals, leaving a tubular whorl ornamented by umbilical bullae and low broad ribs that extend across flanks and venter.

The suture is too poorly preserved for description.

DISCUSSION: The strongly tuberculate acanthoceratine early whorls resemble the larger and poorly preserved nucleus of *Nigericeras scotti* figured by COBBAN (1972, pl. 18, figs 5-7). The outer whorl also recalls American specimens, but the French material reaches maturity at a slightly smaller size. The present specimens also have more numerous and smaller ventrolateral tubercles at a smaller size; on the advice of Dr. W.A. COBBAN (Denver) we identify the specimens as *N. aff. scotti*. They differ from *N. gadeni* (CHUDEAU, 1909, p. 71, pl. 3, fig. 6) (see SCHÖBEL 1975, p. 117, pl. 6, figs 1-3, for additional synonymy) during the juvenile strongly ornamented stage by their quadrate whorl section and flat, rather than arched venter with much weaker siphonal clavi. *N. gadeni* loses its ventral ornament at a much earlier stage than *N. scotti* and has an ovate whorl section.

OCCURRENCE: In the United States *Nigericeras scotti* is confined to a single limestone bed in southeastern Colorado where it occurs with no other ammonites and is index of a local *scotti* Zone above the *juddii* Zone and at the top of the Upper Cenomanian. The present specimens of *N. aff. scotti* were collected loose.

Subfamily Euomphaloceratinae COOPER, 1978  
Genus *Euomphaloceras* SPATH, 1923

TYPE SPECIES: By monotypy, *Ammonites euomphalus* SHARPE (1855, p. 31, pl. 13, fig. 4).

*Euomphaloceras septemseriatum* (CRAGIN, 1893)  
(Pl. 2, Figs 9, 10, 13, 15, 18-23)

1893. *Scaphites septem-seriatus* CRAGIN, p. 240.

1981. *Euomphaloceras septemseriatum* (CRAGIN, 1893);

- WRIGHT & KENNEDY, p. 55, pl. 12, figs 1-8; pl. 13, figs 1-6; pl. 14, figs 5-9 (with full synonymy).
1981. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KENNEDY & JUIGNET, p. 38, figs 9b-d (with synonymy).
1983. *Euomphaloceras septemseriatum* (CRAGIN); FÖRSTER & *al.*, p. 132, pl. 3, figs 6-8.
1984. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KENNEDY & *al.*, p. 36, figs 3k, 1.
1985. *Euomphaloceras* (*Kanabicerus*) *septemseriatum* (CRAGIN); HOWARTH, p. 95, figs 26-29.
1986. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KENNEDY & *al.*, p. 206, fig. 3c, d.
1988. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KENNEDY, p. 53, pl. 8, figs 1-6; pl. 9, figs 1-3, 5, 7, 9-12; pl. 22, fig. 3, text-fig. 10c, 11d.
1989. *Euomphaloceras septemseriatum* (CRAGIN); COBBAN & *al.*, p. 35, figs 35, 76q-t, z-ff, hh-pp (with additional synonymy).
1989. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KENNEDY & *al.*, p. 64, figs 10a-j, 11d-i.
1994. *Euomphaloceras* cf. *septemseriatum* (CRAGIN, 1893); KENNEDY & JUIGNET, p. 492.
1996. *Euomphaloceras septemseriatum* (CRAGIN, 1893); KIRKLAND, p. 85, pl. 16, figs I, J, L-O.

**HOLOTYPE:** By monotypy, TMM 21058 from the Britton Formation, Upper Cenomanian *Sciponoceras gracile* Zone, Keenan's Crossing on the Trinity River, Dallas County.

**MATERIAL:** Ten specimens, JG. 29, 37, 71, 73, 76, 81, 83, 85, 88, 93, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

**DISCUSSION:** COBBAN & SCOTT (1973) and WRIGHT & KENNEDY (1981) described material from chalk and limestone facies in detail; KENNEDY (1988), much better preserved material of this highly variable species from Upper Cenomanian clays and concretions from Texas. The new material from Haute Normandie ranges from juveniles only 14 mm in diameter (Pl. 2, Fig. 15) to body chamber fragments with whorl heights of up to 23 mm (Pl. 2, Figs 20, 21), and shows the same wide morphological and ontogenetic variation documented by previous authors.

**OCCURRENCE:** Widespread in the *Metoicoceras geslinianum* Zone and its correlatives in Haute Normandie, Sarthe, Maine-et-Loire and Aube in France, southern England, the Germany Federal Republic, Angola, Nigeria, Japan, northern Mexico, north-east and

Trans-Pecos Texas, New Mexico, Arizona, Colorado, Kansas, Montana, Utah and California in the United States, and Brazil. *Euomphaloceras* cf. *septemseriatum*? is recorded from Cassis, SE France (CECCA 2000).

Subfamily Mammitinae HYATT, 1900

Genus *Metoicoceras* HYATT, 1903

**TYPE SPECIES:** By subsequent designation by SHIMER & SHROCK (1944, p. 591), *Ammonites swallowi* SHUMARD (1860, p. 591).

*Metoicoceras geslinianum* (D'ORBIGNY, 1850)

(Pl. 3, Figs 1-9; Pl. 5, Figs 4-9)

1841. *Ammonites catillus* D'ORBIGNY, p. 325, pl. 97, figs 1, 2.
1850. *Ammonites geslinianus* D'ORBIGNY, p. 146.
1981. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); WRIGHT & KENNEDY, p. 62, pl. 17, fig. 2; pl. 18, figs 1, 2; pl. 19, figs 1, 2; pl. 20, figs 1-3; pl. 21, figs 1, 2; text-figs 19C-E, 20, 21A-D (with full synonymy).
1981. *Metoicoceras geslinianum* (D'ORBIGNY); KENNEDY & JUIGNET, p. 39, text-figs 7d-e, 8a-c, 9a, e, 10a.
1983. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); FÖRSTER & *al.*, p. 132, pl. 3, figs 12-16.
1983. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); MOREAU & *al.*, p. 335, text-figs 10c, d.
1984. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KENNEDY & *al.*, p. 37.
1986. *Metoicoceras geslinianum* (D'ORBIGNY); COBBAN, figs J, K.
1988. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KENNEDY, p. 58, pl. 91, fig. 8; pl. 10, figs 25-27; pl. 22, figs 16, 17; text-figs 20-23.
1989. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); COBBAN & *al.*, p. 42, figs 84a-w, aa (with additional synonymy).
1989. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KENNEDY & *al.*, p. 77, figs 17a, b; 18a-c.
1991. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); MEISTER & *al.*, p. 66, pl. 2, figs 1, 3; text-fig. 11.
1994. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KENNEDY & JUIGNET, p. 493, figs 11a-d, f-h; 12a, f, g.
- non 1996. *Metoicoceras* cf. *geslinianum* (D'ORBIGNY, 1850); WILMSEN & WIESE, p. 94, pl. 2, fig. 3 (= *Thomelites*? sp.).
1996. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KIRKLAND, p. 89, pl. 17, figs A, B, E, F; Pl. 18, figs A-C.
1998. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); KAPLAN & *al.*, p. 172, pl. 13, figs 19, 20 (with additional synonymy).
1999. *Metoicoceras geslinianum* (D'ORBIGNY, 1850); LEHMANN, pl. 4, fig. 3.

LECTOTYPE: MNHP 6110, said to be from Lamennais near Vibraye, Sarthe, France; designated by KENNEDY & *al.* (1981, p. 64).

MATERIAL: More than twenty specimens in the GIRARD collection, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DISCUSSION: This large collection is quite variable, within the limits described by WRIGHT & KENNEDY (1981) when dealing with material from southern England. As with the material from Devon, England, the Haute Normandie specimens are all much smaller than those from Anjou and Vendée described by KENNEDY & *al.* (1981) and those from Texas (KENNEDY 1988).

OCCURRENCE: Widespread in the Upper Cenomanian *Metoicoceras geslinianum* Zone and correlatives in southern England, France, Spain, Germany, The Czech Republic, Iran (?), Angola, Nigeria, Niger, and possibly Morocco; Texas, New Mexico, Arizona, Colorado, Kansas, Utah and elsewhere in the US Western Interior and northern Mexico. ?*Metoicoceras geslinianum* is recorded from Cassis, SE France (CECCA 2000).

Family Vascoceratidae H. DOUVILLÉ, 1912  
Subfamily Pseudotissotiinae HYATT, 1903  
Genus *Thomasites* PERVINQUIÈRE, 1907

TYPE SPECIES: *Pachydiscus rollandi* PERON (1889, p. 25, pl. 17, figs 1-3); by original designation.

*Thomasites gongilensis* (WOODS, 1911)  
(Pl. 5, Figs 1-3)

1911. *Vascoceras gongilense* WOODS p. 282, pl. 21, fig. 7; pl. 22, fig. 1.

1981. *Thomasites gongilensis* (WOODS, 1911); WRIGHT & KENNEDY, p. 100, pl. 24, fig. 1; pl. 25, fig. 1; including varieties *tectiformis* BARBER, 1957, and *lautus* BARBER, 1957 (with full synonymy).

1989. *Thomasites gongilensis* (WOODS, 1911); MEISTER, p. 38, pl. 16, figs 3-5; pl. 17, figs 1-6; pl. 18, figs 1-3; pl. 19, figs 1-5; pl. 20, figs 1-5; pl. 21, figs 1-3 (with additional synonymy).

HOLOTYPE: SM B3238, from the "Lower Turonian" of Nigeria.

MATERIAL: JG. 42, from the Upper Cenomanian *Neocardioceras juddii* Zone fauna of the lower part of the Craie du Cap Fagnet, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: Specimen is almost completely septate and 53.8 mm in diameter. Coiling is involute with a deep umbilicus comprising 20% of the diameter. The whorl section is depressed, with the greatest breadth at the umbilical shoulder or bulla. The inner flanks are broadly rounded, the outer flanks flattened and convergent, the ventrolateral shoulders broadly rounded, the venter very broad and flattened. There are feeble, blunt umbilical bullae, four or five per half whorl, and these give rise to low, broad prorsiradiate ribs that efface at mid-flank, ventrolateral shoulders and venter. There are an estimated 28-30 blunt, coarse ribs that strengthen into outer ventrolateral tubercles, and these are linked over the venter by a broad, blunt and rather weak rib.

Suture, imperfectly exposed, is characterised by broad, plump, little incised saddles and narrower lobes.

DISCUSSION: The genus and species were not previously known from Haute Normandie. The present specimen differs in no significant respects from *Gombeoceras gongilense tectiforme* (BARBER 1957, p. 41, pl. 17, figs 1, 4; pl. 19, fig. 6; pl. 33, figs 4-6), here regarded as no more than an intraspecific variant of *Thomasites gongilensis*. See WRIGHT & KENNEDY (1981) for a discussion of the relationship of this to other species referred to the genus.

OCCURRENCE: Upper Cenomanian, first appearing just below the base of the *Neocardioceras juddii* Zone as well as in that Zone in Devon, and now in Haute Normandie.

Common in beds formerly described as Upper Cenomanian to Lower Turonian in West Africa, and recorded from Spain.

Suborder Ancyloceratina WIEDMANN, 1966  
Superfamily Turrilitaceae GILL, 1871  
Family Hamitidae GILL, 1871  
Genus *Hamites* PARKINSON, 1811

TYPE SPECIES: *Hamites attenuatus* J. SOWERBY (1814, p. 137, pl. 61, figs 4, 5), by subsequent designation by DIENER (1925, p. 65).

*Hamites cimarronensis* (KAUFFMAN & POWELL, 1977)  
(Pl. 4, Figs 4, 5, 9, 10)

1977. *Stomohamites simplex cimarronensis* KAUFFMAN & POWELL, p. 97, pl. 9, figs 1, 3, 4; text-figs 5, 6.  
 1981. *Hamites* sp. WRIGHT & KENNEDY, p. 100, pl. 32, fig. 1.  
 1988. *Hamites cimarronensis* (KAUFFMAN & POWELL); LUCAS & al., p. 57, fig. 96u.  
 1989. *Hamites cimarronensis* (KAUFFMAN & POWELL); COBBAN & al., p. 57, fig. 96u.  
 1991. *Hamites* sp. KENNEDY & COBBAN, fig. 60o, p. r.  
 1999. *Hamites cimarronensis* (KAUFFMAN & POWELL, 1977); KENNEDY & al., p. 637, figs 4u, c<sup>1</sup>-i<sup>1</sup>.  
 ?2000. *Hamites simplex* D'ORBIGNY, 1842; CECCA, p. 221, fig. 3.7.

**TYPES:** The holotype is USNM 167160; paratypes are USNM 167161-167164, and 167175 and 167176; all are from the Cenomanian Hartland Shale Member of the Greenhorn Limestone of Cimarron County, Oklahoma.

**MATERIAL:** JG. 44 and 46, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

**DESCRIPTION:** No. 44 is a fragment of the curved part of a juvenile at a small size, no. 46 part of a shaft with a whorl height of 13.5 mm. The dorsum and venter show basically identical curvature and the flanks are markedly flattened to give a compressed whorl section with a whorl breadth to height ratio of 0.71. The ribs are only slightly weakened on the dorsum, and only slightly stronger on the venter than on the flanks; blunt, prorsiradiate, with a rib index of 9-10.

**DISCUSSION:** Oval whorl section and high rib density immediately distinguish the species from the long-ranging *Hamites simplex* D'ORBIGNY, 1842 (see KENNEDY & JUIGNET 1983, p. 13, figs 15a-d; 17a-w; 36j; 37v, w), with a rib index of 4.5 - 7, and the ribs sharp rather than blunt.

The *Hamites simplex* D'ORBIGNY, 1842, of CECCA (2000, p. 222; fig. 3.7) from the upper Upper Cenomanian of Cassis, SE France, has a rib index of up to 10, and more closely resembles the present species than *H. simplex*, but is too poorly preserved for firm identification.

**OCCURRENCE:** Upper Cenomanian *Metoicoceras geslinianum* Zone of Eastbourne, Sussex, and Haute Normandie, France. Upper Cenomanian of Colorado, New Mexico and Texas.

Family Anisoceratidae HYATT, 1900

Genus *Allocrioceras* SPATH, 1926a

**TYPE SPECIES:** By original designation: *Crioceras ellipticum* WOODS (1896, p. 84 *non* MANTELL), renamed *Allocrioceras woodsi* (SPATH 1939, p. 598, = *Hamites angustus* J. DE C. SOWERBY, 1850, p. 346, pl. 29, fig. 12).

*Allocrioceras annulatum* (SHUMARD, 1860)  
(Pl.4, Figs 11-15)

1860. *Ancyloceras annulatus* SHUMARD, p. 595.  
 1978. *Allocrioceras annulatum* (SHUMARD); KAUFFMAN, pl. 19, figs 1, 2.  
 1981. *Allocrioceras annulatum* (SHUMARD, 1860); WRIGHT & KENNEDY, p. 111, pl. 32, figs 3-7 (with full synonymy).  
 1984. *Allocrioceras annulatum* (SHUMARD); COBBAN, p. 16, pl. 2, fig. 4.  
 1988. *Allocrioceras annulatum* (SHUMARD, 1860); KENNEDY, p. 104, Pl. 19, figs 3-12; 14; pl. 22, figs 1, 2; pl. 24, fig. 2, text-fig. 36.  
 1989. *Allocrioceras annulatum* (SHUMARD); COBBAN & al., p. 59, fig. 96p.  
 1989. *Allocrioceras annulatum* (SHUMARD, 1861); KENNEDY & al., p. 97, fig. 100p.

**TYPES:** SHUMARD's syntypes were from what is now known as the Britton Formation, Upper Cenomanian, *Sciponoceras gracile* Zone, of Shawnee Creek, Grayson County, Texas and are now lost.

**MATERIAL:** Nine specimens, JG. 55, 60, 62-67 from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

**DESCRIPTION:** This series of fragments range from 6.5 to 28.5 mm whorl height, and all show asymmetry, indicating an open, helicoid shell. The whorl section is compressed oval, the rib index varies from 4-6, the ribs coarse and markedly prorsiradiate on the flank and all bearing small ventral clavi, linked over the venter by a strong rib. None of the specimens show the sutures.

**DISCUSSION:** *Allocrioceras annulatum* is easily distinguished from other species of the genus. *A. larvatum* (CONRAD, 1855) (see KENNEDY 1988, p. 104, pl. 22, figs 6, 7) has alternately tuberculate and non-tuberculate ribs, and planispiral coiling. *A. conlini* KENNEDY (1988, p. 107, text-fig. 37) is characterised by constrictions and associated flared ribs.

**OCCURRENCE:** Upper Cenomanian *Metoicoceras geslinianum* Zone, southern England and Haute Normandie in France, and correlatives in north central and West

Texas, New Mexico, Arizona, Colorado, Kansas, Utah and Wyoming in the USA, and northern Mexico.

Family Baculitidae GILL, 1871  
Genus *Sciponoceras* HYATT, 1894

TYPE SPECIES: *Hamites baculoide* MANTELL (1822, p. 123, pl. 23, figs 6, 7).

*Sciponoceras gracile* (SHUMARD, 1860)  
(Pl. 6, Figs 1-19)

1860. *Baculites gracilis* SHUMARD, p. 596.  
1981. *Sciponoceras gracile* (SHUMARD, 1860); WRIGHT & KENNEDY, p. 112, pl. 31, figs 1-3; pl. 32, figs 8, 11; text-fig. 38a-c (with full synonymy).  
1983. *Sciponoceras gracile* (SHUMARD); KENNEDY & JUIGNET, p. 22, figs 18a-d, 32i-p (with additional synonymy).  
1984. *Sciponoceras gracile* (SHUMARD, 1860); KENNEDY & *al.*, p. 41, figs 2a-d.  
1988. *Sciponoceras gracile* (SHUMARD, 1860); KENNEDY, p. 108, pl. 20, figs 1-4, 17-20; text-fig. 38.  
1989. *Sciponoceras gracile* (SHUMARD); COBBAN & *al.*, p. 61, figs 94a, b; 95g-n; 96a, b.  
1989. *Sciponoceras gracile* (SHUMARD, 1860); KENNEDY & *al.*, p. 101.  
1996. *Sciponoceras gracile* (SHUMARD, 1860); KIRKLAND, p. 103, pl. 38, fig. K.  
?1998. *Sciponoceras* cf. *gracile* (SHUMARD, 1860); LEHMANN, p. 33.  
?2000. Genus *Sciponoceras* cf. *gracile* (SHUMARD, 1860); CECCA, p. 221, Fig. 3.5, 3.6.

TYPES: SHUMARD's types are lost, but are presumed to be from the Upper Cenomanian *Sciponoceras gracile* Zone fauna of the Britton Formation of Grayson County, Texas.

MATERIAL: JG 53-59, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, La Neuville-du-Bosc, Eure, France.

DESCRIPTION: All specimens are fragments of juvenile and adult body chamber. The shell expands slowly, with a slightly compressed oval whorl section. The smaller fragments are smooth or with feeble ventral ribs, and periodic strong constrictions, best developed on the outer flank and venter, where they are markedly convex, and separated by distances of up to twice the whorl height. Larger specimens have whorl heights of

up to 20 mm, and are ornamented by feeble prorsiradial ribs on the inner flank that strengthen markedly on the outer flank and cross the venter in a broad convexity. They have a steep adapertural face and appear markedly scale-like in profile.

DISCUSSION: The present material compares well with topotypes from Texas described by KENNEDY (1988), and further examples illustrated here (Pl. 5, Figs 9-13).

*Sciponoceras bohemicum anterius* WRIGHT & KENNEDY (1981, p. 115, pl. 31, figs 4, 6, 8, 10, 11, ? 7; pl. 32, figs 9, 10, 12-15) has an elliptical whorl section, the flanks flattening progressively through ontogeny, weak ribs and less markedly convex constrictions.

OCCURRENCE: Upper Cenomanian, *Metoicoceras geslinianum* Zone and correlatives in southern England, northern France, Southern Germany, north-east, central and west Texas, Arizona, New Mexico, Colorado, Kansas, Wyoming, Montana, Utah and California in the USA, northern Mexico and, possibly Angola. COBBAN & *al.* (1989) record it extending to slightly higher horizons in New Mexico.

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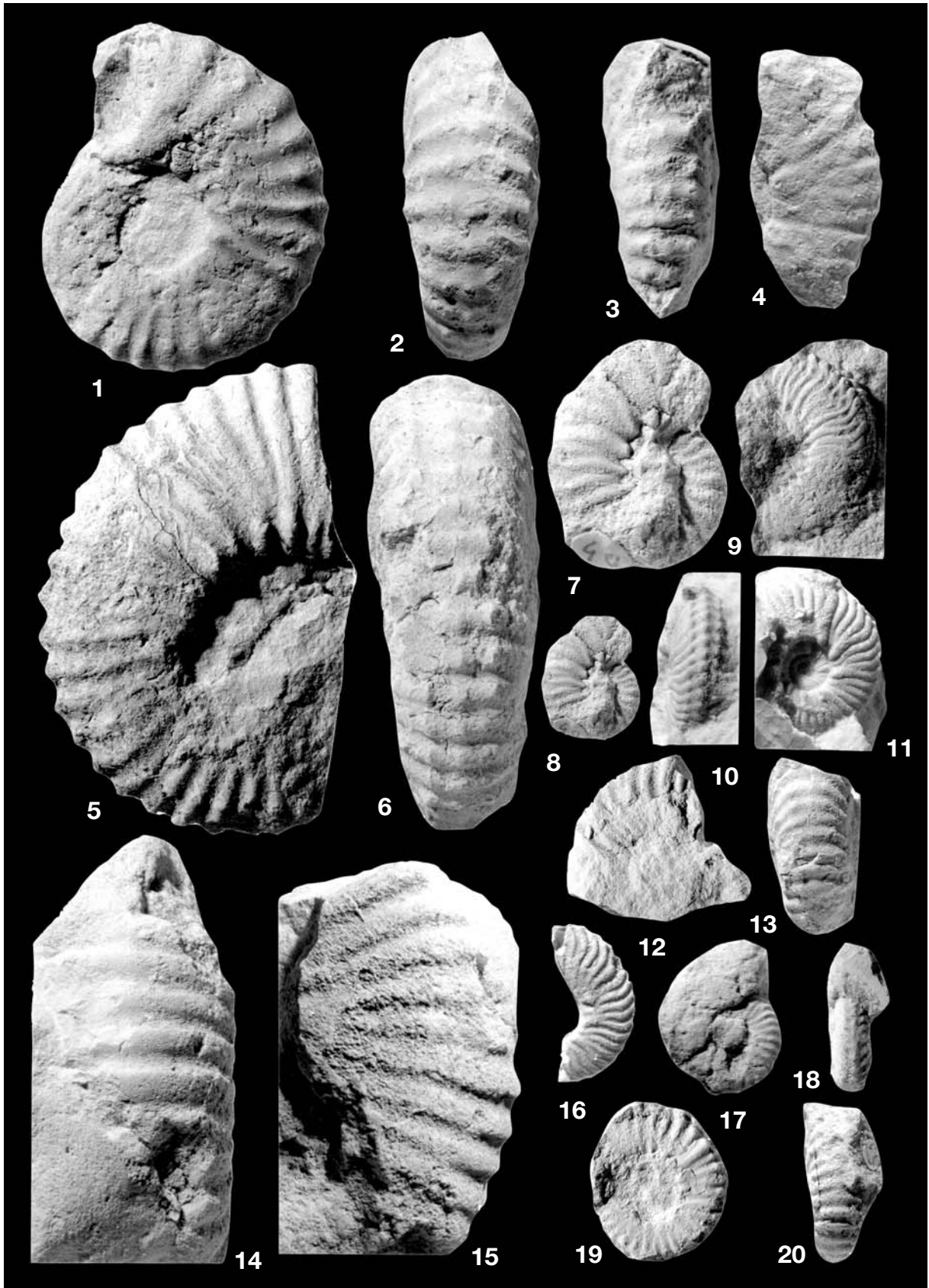
*Revised version accepted: 15th December 2002*

PLATES 1 - 6

## PLATE 1

Upper Cenomanian ammonites from the Trou Tassin Quarry, Eure, Haute-Normandie,  
France

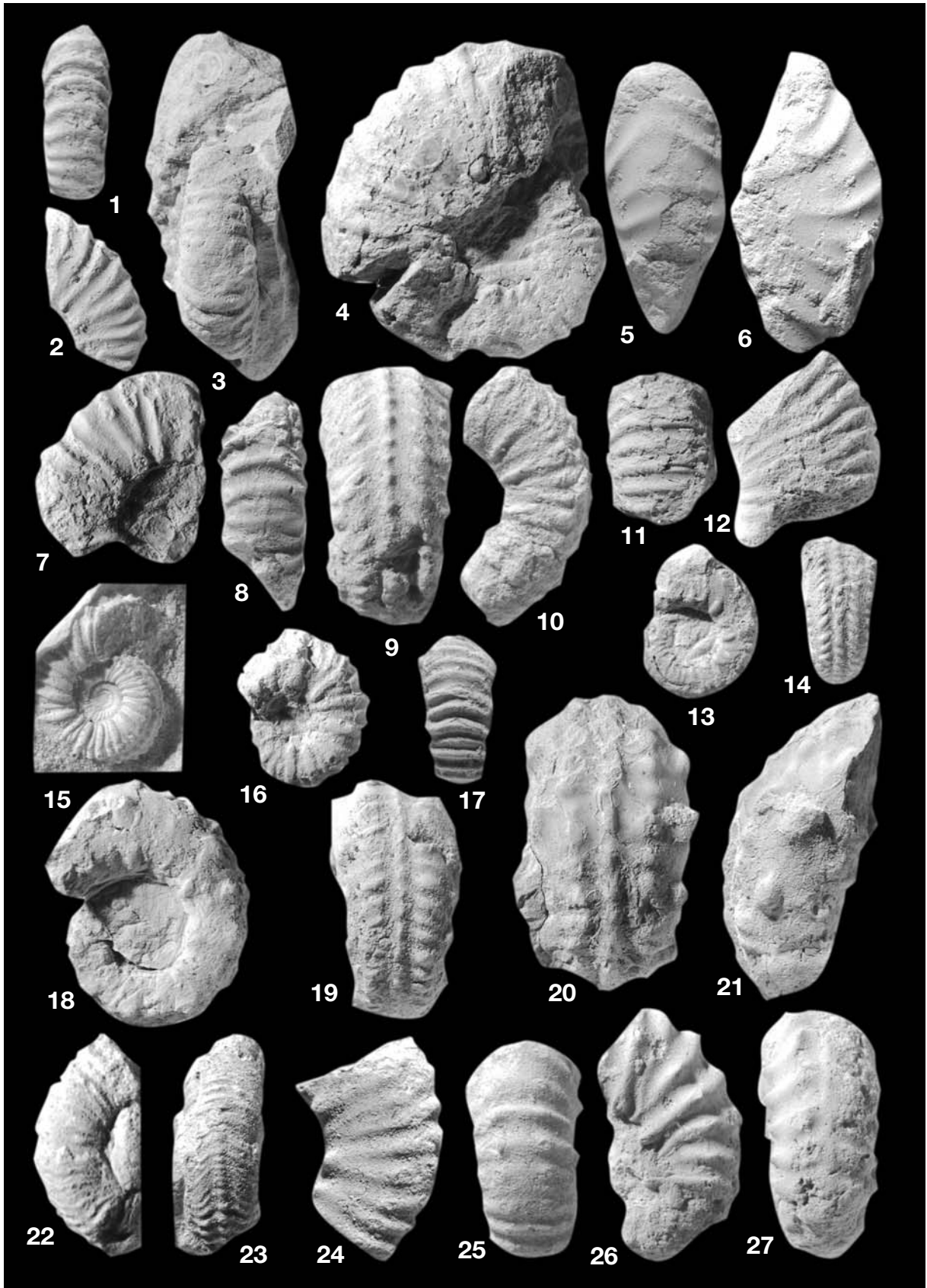
- 1-6** – *Pseudocalycoceras angolaense* (SPATH, 1931); 1, 2, JG.30; 3, 4, JG.28; 5, 6, JG.10, all from the *Metoicoceras geslinianum* Zone Craie d'Antifer; all  $\times 1$ .
- 7, 8** – *Neocardioceras juddii barroisi* WRIGHT & KENNEDY, 1981; JG.40, from the *Neocardioceras juddii* Zone Craie du Cap Fagnet; 7 is  $\times 2$ ; 8 is  $\times 1$ .
- 9-11, 16-18** – *Neocardioceras juddii juddii* (BARROIS & GUERNE, 1878); 9, JG.38; 10, 11, JG.35; 16, JG.50; 17, 18, JG.37, from the *Neocardioceras juddii* Zone Craie du Cap Fagnet. 9, 10, 11, 16 are  $\times 2$ ; Figs 17, 18, are  $\times 1$ .
- 12, 13** – *Sumitomoceras cautisalbae* WRIGHT & KENNEDY, 1981; JG.15, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer;  $\times 1$ .
- 14, 15** – *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896). JG.05, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer;  $\times 1$ .



## PLATE 2

Upper Cenomanian ammonites from the Trou Tassin Quarry, Eure, Haute-Normandie,  
France

- 1, 2, 7, 8, 24, 25** – *Sumitomoceras cautisalbae* (WRIGHT & KENNEDY, 1981); 1, 2, JG.26; 7, 8, JG.56, 24, 25, JG.06 from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer; 1, 2, 7, 8, × 1; 24, 25, × 2.
- 3, 4** – *Eucalycoceras pentagonum* (JUKES-BROWNE, 1896); JG.29, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer; × 1.
- 5, 6** – *Pachydesmoceras* sp. JG.43, collected loose; × 1.
- 9, 10, 13-15, 18-22** – *Euomphaloceras septemseriatum* (CRAGIN, 1893); 9, 10, JG.83; 13, 14, JG.37; 15, JG.71; 18, 19, JG.93; 20, 21, JG.93; 22, 23, JG.76, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer. 9, 10, 15, 22, 23 are × 2; 13, 14, 18-21 are × 1.
- 11, 12** – *Sumitomoceras* cf. *conlini* (WRIGHT & KENNEDY, 1981); JG.88, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer; × 1.
- 16, 17** – *Calycoceras* (*Calycoceras*) sp. juv. JG.58, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer; × 1.
- 26, 27** – *Nigericeras* aff. *scotti* COBBAN, 1972; JG. 25, collected loose; × 1.



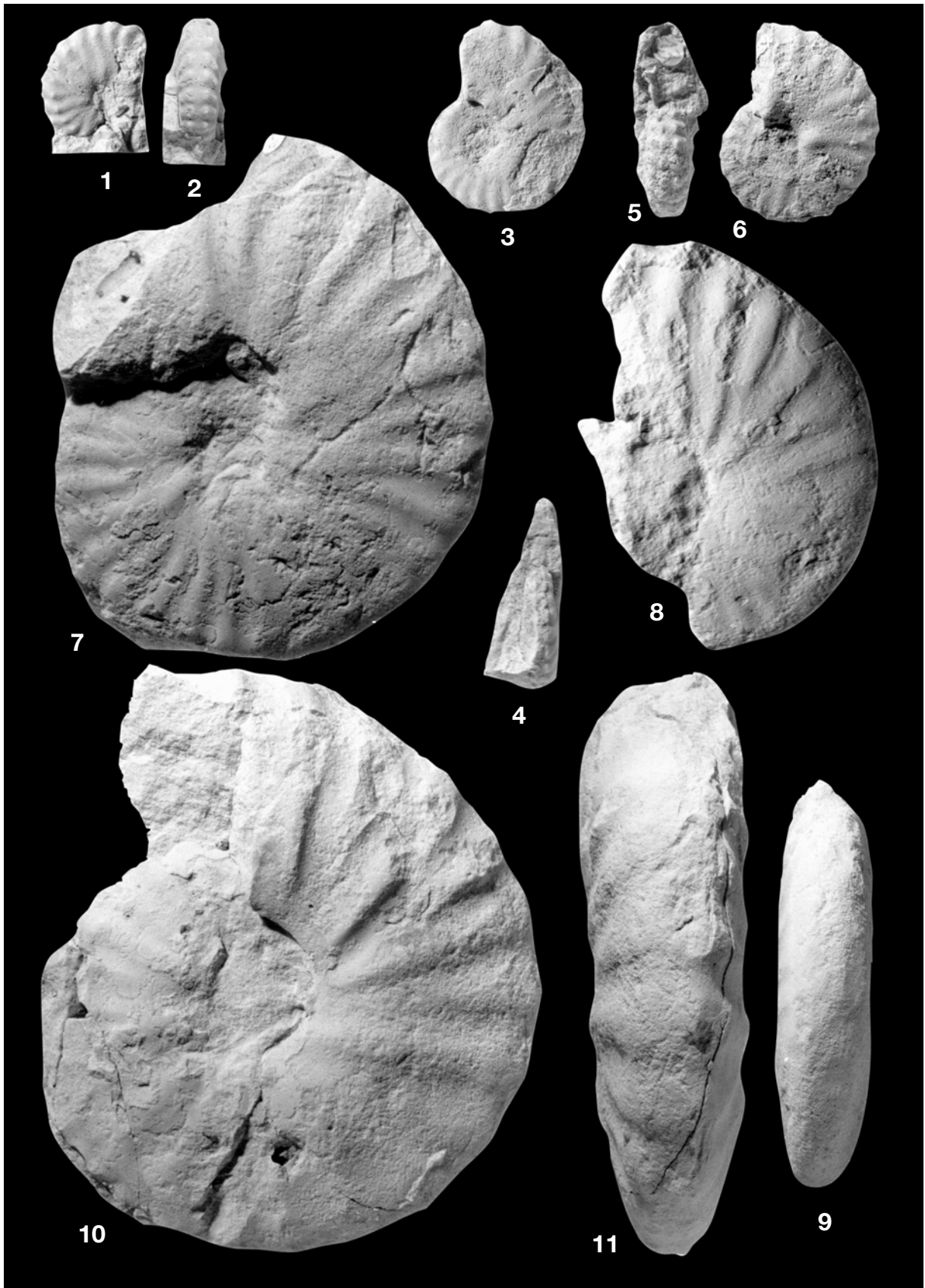
### PLATE 3

Upper Cenomanian ammonites from the Trou Tassin Quarry, Eure, Haute-Normandie,  
France

**1-11** – *Metoicoceras geslinianum* (D'ORBIGNY, 1850). 1-2, JG.58; 3-4, JG.57; 5-6, JG.13; 7,  
JG.14; 8-9, JG.31; 10-11, JG.17, all from the *Metoicoceras geslinianum* Zone fauna  
of the Craie d'Antifer.

All figures are  $\times 1$ .





## PLATE 4

Upper Cenomanian ammonites from the Trou Tassin Quarry, Eure, Haute-Normandie,  
France

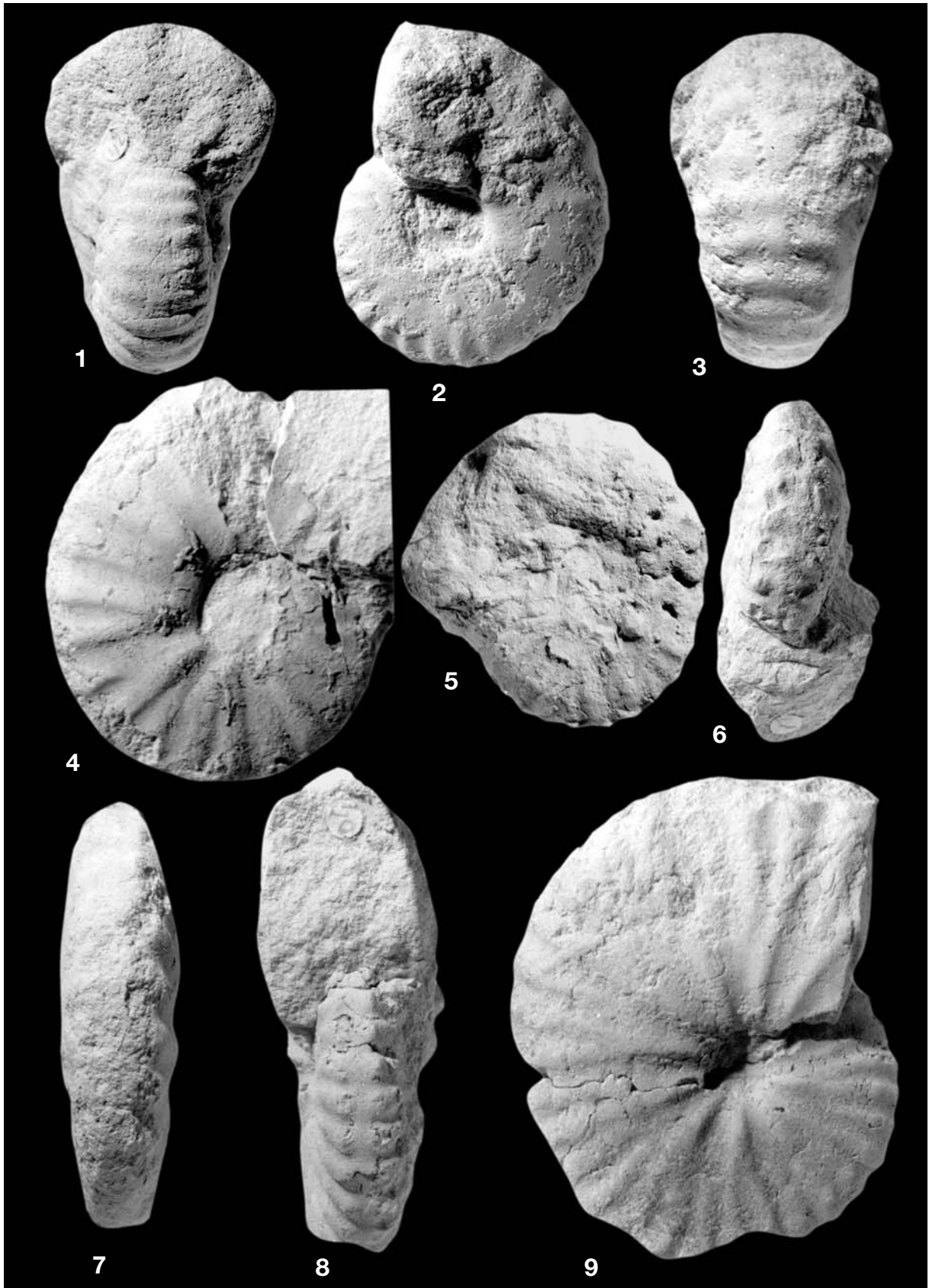
- 1-3** – *Nigericeras* aff. *scotti* COBBAN, 1972. JG. 23, collected loose.  $\times 1$ .  
**4, 5, 9, 10** – *Hamites cimarronensis* (KAUFFMAN & POWELL, 1977). 4, 5, JG.46; 9, 10, JG.44, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antife; 4, 5, 9,  $\times 1$ ; 10,  $\times 2$ .  
**6-8** – *Thomelites serotinus* WRIGHT & KENNEDY, 1981. JG.13, from the *Metoicoceras geslinianum* Zone fauna of the Craie du Cap Fagnet;  $\times 1$ .  
**11-15** – *Allocrioceras annulatum* (SHUMARD, 1860). 11, 12, JG.67; 14, 15, JG.63, from the *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer;  $\times 1$ .



## PLATE 5

Upper Cenomanian ammonites from the Trou Tassin Quarry, Eure, Haute-Normandie,  
France

- 1-3 – *Thomasites gongilensis* (WOODS, 1911). JG.42, from the *Neocardioceras juddii*  
Zone of the Craie du Cap Fagnet; × 1.
- 4, 7-9 – *Metoicoceras geslinianum* (D'ORBIGNY, 1850). 4, 7, JG.05; 8, 9, JG.04, from the  
*Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer; × 1.
- 5, 6 – *Thomelites serotinus* WRIGHT & KENNEDY, 1981. JG.21, from the *Neocardioceras*  
*juddii* Zone fauna of the Craie du Cap Fagnet; × 1.



## PLATE 6

**1-19** – *Sciponoceras gracile* (SHUMARD, 1860). 1-8, 14-19, JG.55-59, from the Upper Cenomanian *Metoicoceras geslinianum* Zone fauna of the Craie d'Antifer, Trou Tassin Quarry, Eure, Haute Normandie, France. 9-13, U.S. National Museum of Natural History Collections (*ex* RENFRO Collection), from the Upper Cenomanian *S. gracile* Zone fauna of the Tarrant Member of the Eagle Ford Group of central Texas.

All figures are  $\times 1$

