Acta Geologica Polonica, Vol. 65 (2015), No. 4, pp. 437–494
DOI: 10.1515/agp-2015-0020

Turonian ammonite faunas from the southern Corbières, Aude, France

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ABSTRACT:

Kennedy, W.J., Bilotte, M. and Melchior, P. 2015. Turonian ammonites from the Corbières, Aude, France, *Acta Geologia Polonica*, **65** (4), 437–494, Warszawa.

The Turonian successions of the southern Corbières comprise three transgressive-regressive cycles in which ammonites occur in three intervals. The lowest comes from the glauconitic basal transgressive unit of the first cycle, and comprises 21 species, including *Kamerunoceras douvillei* (Pervinquière, 1907), *Kamerunoceras turoniense* (d'Orbigny, 1850), *Spathites* (*Jeanrogericeras*) *revelerianus* (Courtiller, 1860), *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856), *Mammites nodosoides* (Schlüter, 1871), *Mammites powelli* Kennedy, Wright and Hancock, 1987, *Fagesia tevestensis* (Péron, 1896), *Neoptychites cephalotus* (Coutiller, 1860), *Thomasites rollandi* (Thomas and Péron, 1889), *Wrightoceras wallsi* Reyment, 1954, and *Choffaticeras* (*Choffaticeras*) *quaasi* (Péron, 1904). This is a Lower Turonian assemblage referred to the *Mammites nodosoides* Zone, although the possibility that elements from the preceding *Fagesia catinus* Zone are also present cannot be excluded.

The fauna from the transgressive glauconitic interval of the succeeding cycle comprises nine species, including *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938, *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka, 1864), *Pseudotissotia galliennei* (d'Orbigny, 1850), *Collignoniceras woollgari* (Mantell, 1822) *sensu lato*, *Coilopoceras springeri* Hyatt, 1903, and *Eubostrychoceras* (*Eubostrychoceras*) *saxonicum* (Schlüter, 1872). They indicate the Middle Turonian *Romaniceras* (*R.*) *mexicanum* and *R.* (*Y.*) *ornatissimum* zones.

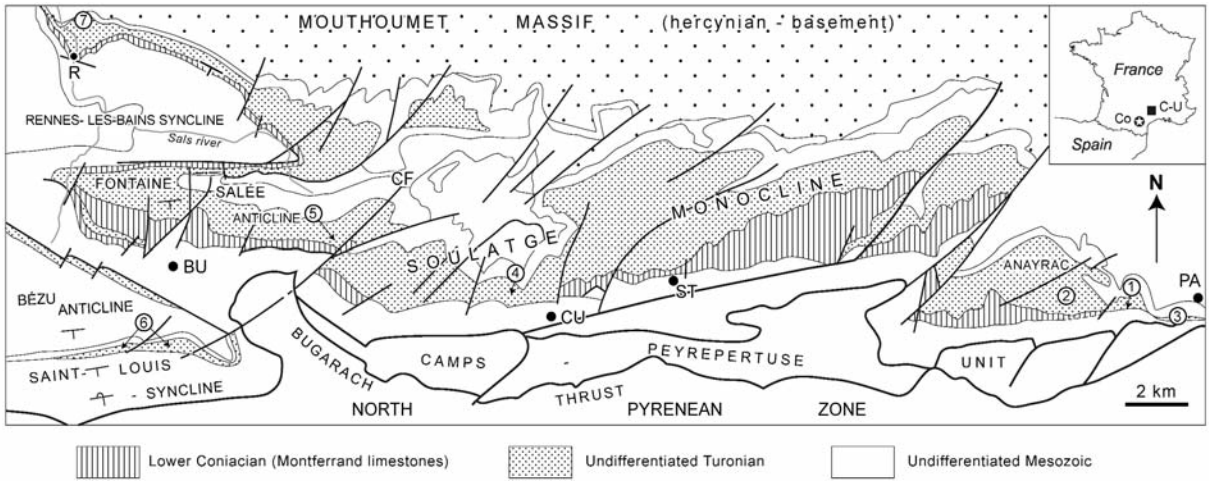
The highest fauna, from the Marnes supérieurs de Saint-Louis of the Saint-Louis syncline, is: *Subprionocyclus* sp. juv., *Prionocyclus* sp. and *Worthoceras* cf. *rochatianum* (d'Orbigny, 1850). The *Subprionocyclus* are minute individuals that resemble *S. bravaisianus* (d'Orbigny, 1841), and suggest the presence of the lower Upper Turonian *bravaisianus* Zone.

Keywords: Ammonites; biostratigraphy; Turonian; Cretaceous; France.

INTRODUCTION

Previous work

Turonian ammonites were recorded by previous authors from two classic sites in the southern Corbières (Text-fig. 1). The earliest, noted by Roussel (1895), was in the environs of Padern; the second, noted by Jacob (1938) was in the environs of Saint Louis. Systematic accounts of the faunas are limited to a single species, *Pachydiscus linderi*, described by de Grossouvre (1894) from the environs of Padern (although originally re-



Text-fig. 1. Simplified geological map showing the distribution of the main ammonite-bearing Turonian outcrops on the southern limb of the Mouthoumet Massif in the southern Corbières. 1 – Padern (historic outcrop); 2 – Marsa; 3 – La Ferrière; 4 – Baillesats; 5 – Les Capitaines-Le Linas; 6 – Montplaisir-Parahou; 7 – Rennes-les-Bains. BU – Bugarach; CU – Cubières; PA – Padern; R – Rennes-les-Bains; ST – Soulatgé; CF – Capitaines fault

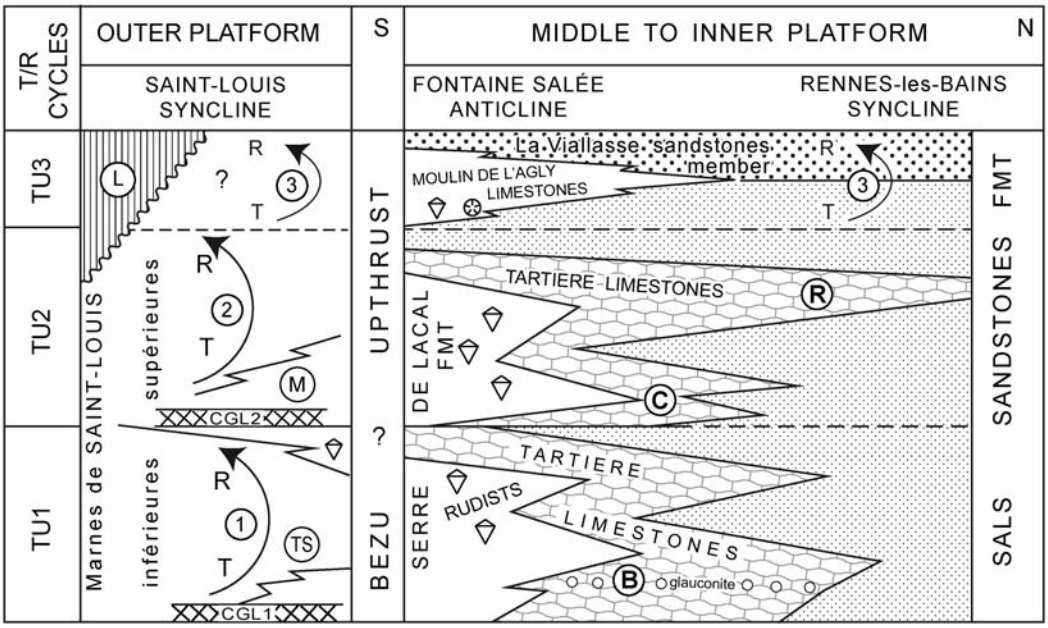
garded as coming from the "partie inférieur de l'étage sénonien), and a more diverse assemblage, also from the environs of Padern, collected by M.P. Sénesse, and described by Basse (1939). Subsequent accounts have been largely biostratigraphic in nature (Sénesse 1937; Bilotte and Calandra 1981; Bilotte 1982, 1984, 1985; Godet *et al*. 1988). Lithostratigraphic and sedimentological investigations of the Turonian sucessions of the area (Bilotte 1993) have led to the recognition of three regressive-transgressive sedimentary cycles. The first two (Tu1, Tu2) are referred to the early and middle Turonian; the transgressive intervals are characterised by diverse faunas, including ammonites. The third sedimentary cycle (Tu3) can only be recognised in the middle and internal platform, and accumulated during the late Turonian; there are no ammonites in the deposits of this cycle. Within the first two cycles, ammonites are frequent in the transgressive intervals; the mid-platform carbonates yield less diverse faunas of limited stratigraphic interest.The outer platform deposits of the Saint-Louis syncline yield a limited association that may be lower Upper Turonian.

Regional geology

In the southern Corbières, Turonian deposits succeed internal and mid-platform Cenomanian successions characterised by caprinid rudists and benthic microfaunas, and outer platform successions with planktonic microfaunas (Bilotte 1984, 1985). They are overlain by the Calcaire de Montferrand, an inner and mid-platform sequence that has yielded the latest Turonian-early Coniacian marker ammonite *Forresteria* (*Harleites*) *petrocoriensis* (Coquand, 1859) (Kennedy *et al*. 1995), and its outer platform correlative, the Marnes à *Micraster* which extends from the Coniacian into the early Santonian, and yields ammonites and planktonic foraminifera. There is an erosional break at the base of the succeeding late Santonian Grès de Labastide that has removed parts of the underlying sequence.

Lithostratigraphy

On the southern flank of the Massif de Mouthoumet, sediments of Turonian age are well-developed between Padern in the east, and Rennes-les-Bains in the west (Text-fig. 1). To the east of the Capitaines fault, the sequence dips uniformly to the south in the Soulatge monocline. To the west, the Turonian is involved in a series of folds; from the north to south, these are the Rennes-les-Bains syncline, the Fontaine Salée anticline, the Bézu anticline, and the Saint-Louis syncline. With the exception of the Saint-Louis syncline, where the Marnes de Saint-Louis are a series of outer platform deposits, the remaining structures expose mid-platform carbonates that include rudistid bioconstructional limestones (Serre de Lacal Formation and the Calcaires des Moulin de l'Agly Member), inner platform limestones with caulerpales (the Calcaires de la Tartière Member), and terrigenous-clastic units (the Grès de Sals Formation and the Grès de la Viallasse Member: Bilotte 1993). These different formations and members together make up the three transgressive-regressive cycles noted above, and summarised in Text-fig. 2.



Text-fig. 2. Turonian lithological units and sedimentary cycles on the southern limb of the Mouthoumet massif in the southern Corbières, with the position of the main ammonite-bearing outcrops mentioned in the text: TR1-3 – transgressive-regressive cycles. CGL1, CGL2 – transgressive glauconite-bearing condensed units. TS – Trou des Sorcières; M – Montplaisir; B – Baillesats ; C – Les Capitaines-Le Linas; R – Rennes-les-Bains; L – Grès de Labastide (late Santonian)

Depositional sequences

In the transgressive-regressive cycle Tu1 (Text-fig. 2), the first unit of regional extent is the basal transgressive condensed glauconitic limestone CGL1 (Text-fig. 2); this is the case at the historical outcrop of Padern described by Roussel (1895). On the north side of the Saint-Louis syncline it is only 20 cm thick, with abundant small brachiopods (*Orbirhynchia cuvieri* (d'Orbigny, 1847): Sénesse 1937; Gélard 1969; Bilotte and Calandra 1981). It has yielded a large *Mammites*. A comparable glauconitic unit, albeit less markedly so, crops out on the south side of the Fontaine Salée anticline to the west of Cubières, on the track that leads to the farm of Baillesats (Bilotte 1985, p. 138; x=609.330; y=063.100) There are also traces of this glauconitic unit north of Rennes-les-Bains, in the bed of the River Sals. On the external platform the condensed unit is overlain, in the Saint-Louis syncline, by the fine-grained terrigenous-clastics of the lower member of the Marnes de Saint-Louis. In the mid-platform, it is succeeded by a heterogeneous sequence of carbonates (bioconstructional limestones with rudists, bioturbated nodular limestones) of the Tartière facies, in the Fontaine Salée anticline. On the internal platform, the deltaic facies of the Grès de la Sals is the dominant element of the sequence in the Rennes-les-Bains syncline.

In the succeeding transgressive cycle, Tu2 (Text-fig. 2), the second glauconitic condensed unit, CGL 2 is richly fossiliferous (Jacob 1938; Bilotte and Calandra 1981; Bilotte 1985), but has only been recognised on the north flank of the Saint-Louis syncline, within the Calcaires de Montplaisir. In the middle platform the sequence and distribution of lithologies is as in sequence Tu1, with an association of bioconstructional rudistid limestones and bioturbated nodular limestones of the Tartière facies. These are well-developed in the Rennes-les-Bains syncline, where the terrigenous-clastic Grès de la Sals is otherwise dominant.

The external platform deposits of transgressive cycle Tu3 have been partialy removed by erosion in the Saint-Louis syncline, where they are overlain unconformably by the late Santonian Grès de la Bastide. Mid- to inner platform deposits of this cycle are present on the south flank of the Fontaine Salée anticline. The sequence begins with a fine-grained terrigenous-clastics, overlain by coral-rudist limestones of the Calcaire de Moulin de l'Agly, in turn succeeded by the highest unit of the Turonian, the coarse-grained terrigenous-clastics of regional extent: the Grès de la Viallasse (Bilotte 1993).

THE AMMONITE FAUNAS

The present account deals with more than 150 individuals assigned to 33 species (including those left in open nomenclature). The overwhelming majority are in-

ternal moulds, often poorly preserved. In spite of this, they provide a significant addition to our knowledge of the Turonian ammonite faunas of the southern Corbières.

Locality details

The environs of Padern (Text-fig. 3)

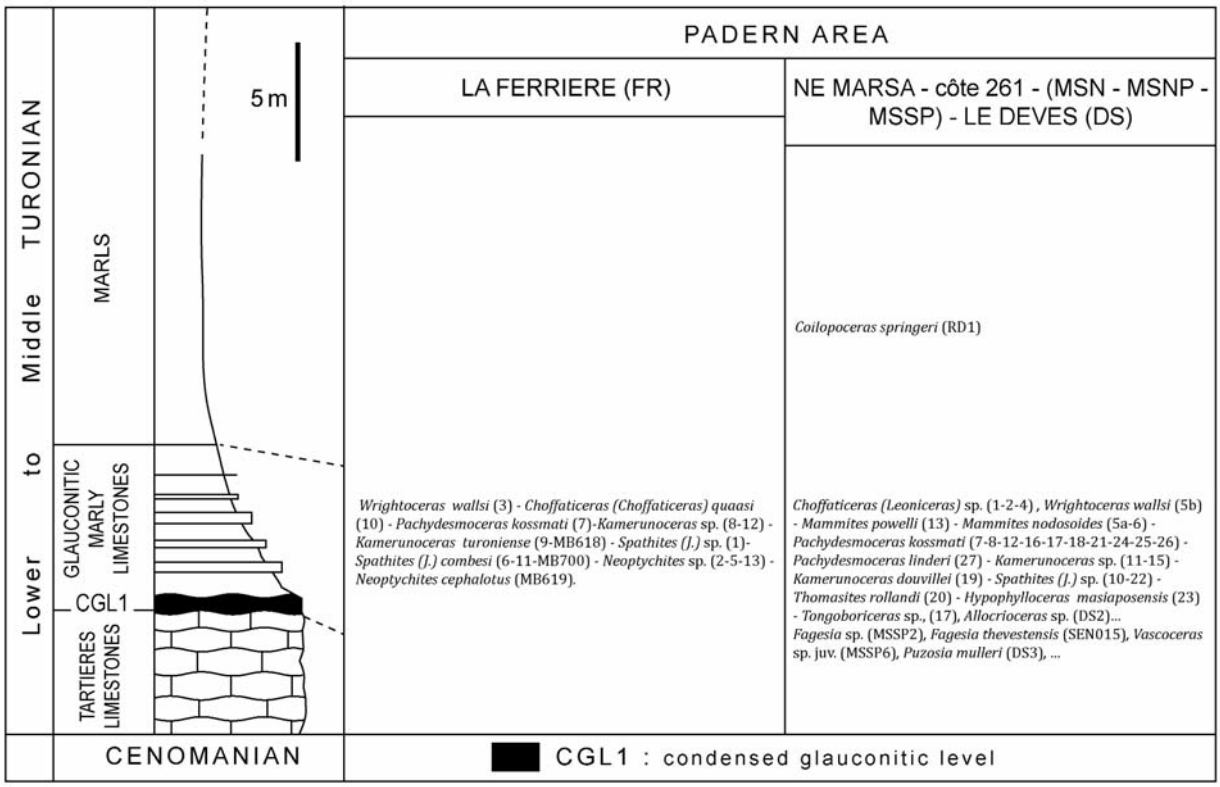
The classic locality of Roussel (1985) is situated 1250 m west of Padern, south of the "Escampillasses", close to the ruins of Gournet (x=609.330; y=063.100). There is a further outcrop (La Ferrière) at the junction between the D. 14 road and the track that crosses the Verdouble and leads to Le Devès (x=622.000; y=063.500). The Turonian succession records progressive deepening, beginning with grey and yellow nodular limestones of the Tartière facies that become slightly glauconitic at the top. The nodularity is the result of the intensive bioturbation. The sequence is interpreted as having been deposited in a sheltered mid-platform environment, and yields abundant debris of caulerpales (*Halimeda ellioti*), and an abundant macrofauna of bivalves (*Cardium*) and echinoids (*Hemiaster*). The succeeding brown marly limestones are rich in glauconite, and are interpreted as the transgressive interval of the Tu1 sequence (Bilotte 1993); they pass up into a sequence of uniform marls. Ammonites present include *Kamerunoceras turoniense* (d'Orbigny, 1850), *Neoptychites cephalotus* (Courtiller, 1860), *Choffaticeras* (*C.*) *quaas*i (Péron, 1904), and *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856).

To the west of the classic Padern locality, the Tartière facies makes up much of Anayrac, Le Devès, Roc de Redounel, and the country north of Marsa (x=623.500; y=063.750) which are refered to here as the Padern area. This is the area that yielded the material described by Basse (1939). That which we have recognised in the Montpellier Collections is revised below, and includes *Neoptychites cephalotus*, *Wrightoceras* sp. juv., and *Fagesia tevesthensis* (Péron, 1896).

The Saint-Louis syncline (Text-fig. 4)

The facies here are of mid- and outer platform type, and there are numerous outcrops. The glauconitic fossiliferous levels of transgressive sequences Tu1: CGL1, and Tu2: CGL2, are both represented.

Cenomanian limestones with prealveoline benthic foraminifera are overlain by the glauconitic limestones of the Tu1 sequence that are crowded with *Orbirhynchia cuvieri*, as noted by all of the previous workers on the Turonian of the area, including Sénesse (1937), Basse (1939), Gélard (1969), and Bilotte and Calandra (1981).



Text-fig. 3. The principal Turonian ammonite associations, plotted against the lithostratigraphic sequences in the environs of the Padern area: La Ferrière and Marsa outcrops

It is overlain by a sequence of marls with glauconite pellets. The locality known as the Trou des Sourcières (Lambert coordinates x= 599.600; y= 062. 425) has yielded *Spathites* (*Jeanrogericeras*) *revelerianus* (Courtiller, 1860) and the echinoid *Typocidaris ligeriensis* (Cotteau, 1859) (Sénesse 1937; Godet *et al*. 1988).

The Tu2 transgressive sequence overlies a hardground at the top of the Calcaires de Montplaisir. The condensed intervals of sequences Tu1 and Tu2 are intercalated within the glauconitic Marnes de Saint-Louis. The interval above the second (CGL2) yields *Pachydesmoceras kossmati* Matsumoto, 1987, *Romaniceras* (*R.*) *mexicanum* Jones, 1938, *Prionocyclus* sp., and *Subprionocyclus* sp. juv. These marls are unconformably overlain by the late Santonian Grès de la Bastide.

The Fontaine Salée anticline

North of Cubières, the access road to Baillesats crosses a major development of the Calcaires de la Tartière (x=609.330; y=063.100) A short distance above the base of the Turonian succession, glauconite-rich limestones yield a Lower Turonian ammonite assemblage including Mammitinae (MB594=M8), *Choffaticeras* (*Leoniceras)* sp. (MB595, BS2), *Spathites (Jeanrogericeras*) *combesi* (MB596), *Pachydesmoceras* sp. (MB599), and *Mammites* cf. *powelli* (BS1) indicating the condensed unit CGL1.

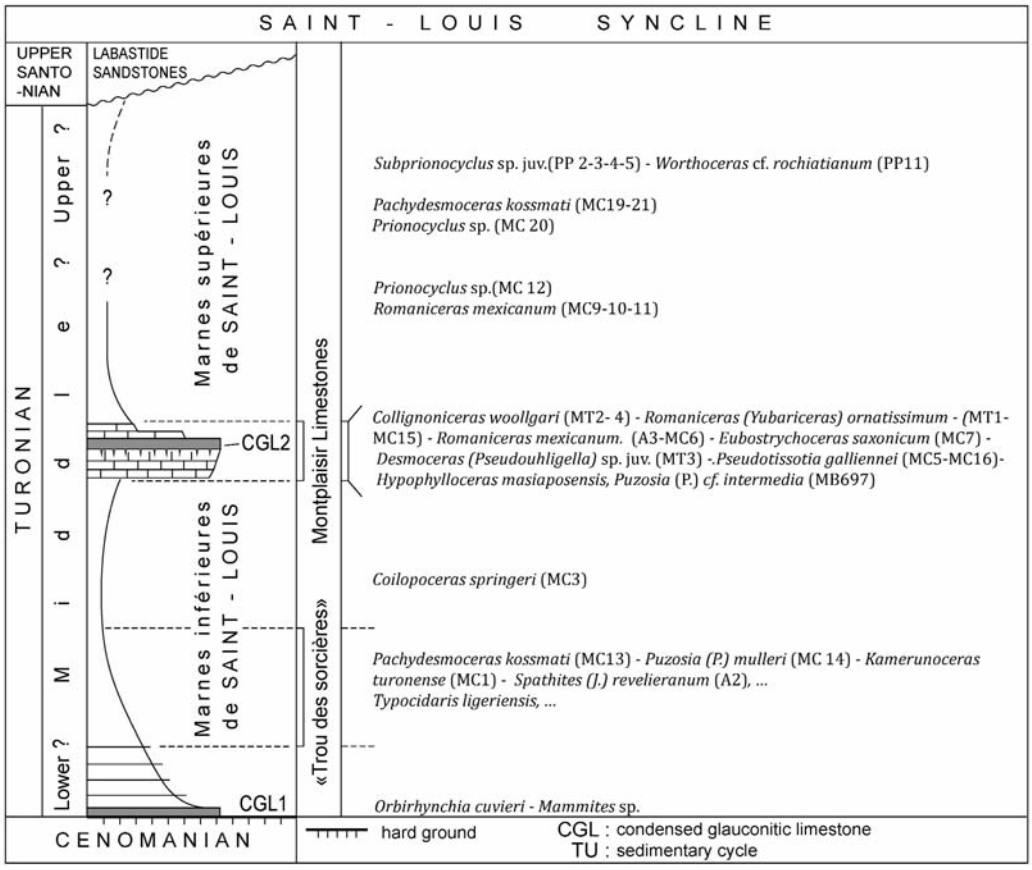
To the east of Les Capitaines, at the side of the D14 (x=605.350; y=064.500), the presence of *Romaniceras* (*R.*) *mexicanum* associated with *Puzosia* (*P.*) cf. *intermedia* Kossmat, 1898, *P.* (*P.*) *mulleri* de Grossouvre, 1894 and *Tetragonites epigonus* Kossmat, 1894, indicates the condensed unit CGL2.

The Rennes-les-Bains syncline

The Calcaires de la Tartière are up to 12 m thick in the environs of Rennes-les-Bains, and represent part of transgressive-regressive cycle Tu2; the upper part yields *Romaniceras mexicanum* and *Coilopoceras springeri*.

Turonian ammonite zones

The ammonite faunas described below are interpreted in terms of the zonation proposed for southern Europe by Robaszynski and Amédro *in* Robaszynski *et al*. (2014, p. 107, text-fig. 32) in their account of the



Text- fig. 4. The principal Turonian ammonite associations, plotted against the lithostratigraphic sequence in the Saint-Louis syncline

Cenomanian to Coniacian successions in the massifs d'Uchaux (Vaucluse) and de la Cèze (Gard) in south-eastern France, 230 km to the northeast of the southern Corbières. It is important to note that although there is an international agreement on the base of the Turonian Stage: at the first occurrence of the ammonite *Watinoceras devonense* Wright and Kennedy, 1981, at the base of bed 86 of the Bridge Creek Member of the Greenhorn Limestone Formation in the Rock Canyon anticline east of Pueblo, Colorado (Kennedy *et al*. 2005), there is no such agreement on the boundaries of the Turonian substages, or, indeed, the base of the Coniacian Stage.

The Lower/Middle Turonian boundary favoured by many authors is the first occurrence of the ammonite *Collignoniceras woollgari* (Mantell, 1822), as suggested by Robaszynski (compiler) (1983) and Bengtson (compiler) (1996). This species is the index of a widely used zone in northern Europe. In terms of the scheme proposed by Robaszynski and Amédro *in* Robaszynski *et al.* (2014) this lies at the base of their *Kamerunoceras turoniense* Zone. It is important to note, however, that *K. turoniense* (d'Orbigny, 1850) first occurs in the upper Lower Turonian, in association with *Mammites nodosoides* (Schlüter, 1871) in Tunisia (Chancellor *et al*., 1994), and New Mexico in the United States Western Interior (Cobban and Hook 1983).

The conclusions of the 1995 symposium on Cretaceous Stage boundaries (Bengtson, compiler, 1996) failed to make a recommendation of the base of the Upper Turonian Substage, noting that two possibilities were either the first occurrence of *Romaniceras deverianum* (d'Orbigny, 1841) or the first occurrence of *Subprionocyclus neptuni* (Geinitz, 1850). Definition of the Middle-Upper Turonian boundary is discussed at length by Robaszynski and Amédro *in* Robaszynski *et al*. (2014, pp. 108–109, 165–174), who propose the first occurrence of *Romaniceras deverianum* (d'Orbigny, 1841. The sequence in the Uchaux Massif provides the best documented sequence across the interval in France. Here, a *Romaniceras* (*R*.) *mexicanum* Zone is succeeded by a *Romaniceras* (*R*.) *deverianum* Zone, where they record the index species associated with *Gaudryceras mite* (Hauer, 1866), *Puzosia* (*P*.) cf. *mayoriana* (d'Orbigny, 1841), *Puzosia* (*Mesopuzosia*) *gaudemarisi* Roman and Mazerin, 1913, *Puzosia* (*Anapuzosia*) sp., *Pachydesmoceras linderi* (de Grossouvre, 1894), *Lewesiceras mantelli* Wright and Wright, 1951, *Tongoboryceras rhodanicum* (Roman and Mazeran, 1913), *Coilopoceras requienianum* (d'Orbigny, 1841), and *Scaphites geinitzii* (d'Orbigny, 1850). There are no associated collignoniceratids. The succeeding *Subprionocyclus bravaisianus* Zone yields, in addition to the index species, of which Robaszynski and Amédro (in Robaszynski et al. 2014) regard *S. neptuni* as a junior synonym, *Lewesiceras mantelli* Wright and Wright, 1951, *Subprionocyclus hitchinensis* Billinghurst, 1927, *S. branneri* (Anderson, 1902), *Coilopoceras requienianum* (d'Orbigny, 18941), *Hyphantoceras reussianum* (d'Orbigny, 1850), *Scalarites gracilis* (d'Orbigny, 1850), *Baculites undulatus* (d'Orbigny, 1850), *Baculites* sp., *Scaphites geinitzii*, and *Worthoceras rochatianum* (d'Orbigny, 1850).

Given the absence of collignoniceratids in association with *Romaniceras* (*R*.) *deverianum* in the Uchaux sequence, the possibility that *Subprionocyclus bravaisianus* might first appear in association with *R*. (*R*.) *deverianum* elsewhere cannot be excluded. The records from Champs Dey near Troyes in Aube (France) (Amédro *et al*. 1982; Kennedy *et al*. 1986), where *Romaniceras* (*R*.). *deverianum* is associated with *Collignoniceras woollgari* is problematic.

Age and affinities of the faunas

The fauna, from the transgressive glauconitic interval of the Tu1 cycle is:

Phylloceras (*Hypophylloceras*) *masiaposensis* Collignon, 1956*, Puzosia* (*Puzosia*) *mulleri* de Grossouvre, 1894*, Pachydesmoceras kossmati* Matsumoto, 1987 *, Pachydesmoceras linderi* de Grossouvre, 1894*, Tongoboryceras* sp., *Kamerunoceras douvillei* (Pervinquière, 1907)*, Kamerunoceras turoniense* (d'Orbigny, 1850), *Spathites* (*Jeanrogericeras*) *revelieranus* (Courtiller, 1860), *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856)*, Mammites nodosoides* (Schlüter, 1871), *Mammites powelli* Kennedy, Wright and Hancock, 1987*, Vascoceras* sp. juv., *Fagesia tevestensis* (Peron, 1896)*, Fagesia* sp. juv., *Neoptychites cephalotus* (Courtiller, 1860)*, Thomasites rollandi* (Thomas and Péron, 1889)*, Wrightoceras wallsi* Reyment, 1954b, *Wrightoceras* sp. juv., *Choffaticeras* (*Choffaticeras*) *quaasi* (Péron, 1904), *Choffaticeras* (*Leoniceras*) sp., and *Sciponoceras* sp.?

The presence of the index species indicates the Lower Turonian *nodosoides* Zone, and the majority of these taxa can be assigned to the zone on the basis of occurrences elsewhere noted in the following systematic section. Not all of the species present are restricted to the zone. The only indication of a lower horizon is the presence of *Mammites powelli* Kennedy, Wright and Hancock, 1987 (p. 42, pl. 3, figs 1–4; pl. 4, figs 16, 17; text-fig. 2f, g). Originally described from the *Pseudaspidoceras flexuosum* Zone of Trans-Pecos Texas, it occurs there in association with abundant *Fagesia catinus*

(Mantell, 1822). Its occurrence in the present fauna may indicate the presence of some *catinus* Zone material in the CGL1 fauna of the transgressive interval of the Tu1 cycle.

The fauna from the transgressive glauconitic interval of the Tu2 cycle is: *Phylloceras* (*Hypophylloceras*) *masiaposaensis, Tetragonites epigonus* (Kossmat, 1895)*, Puzosia* (*Puzosia*) cf. *intermedia* Kossmat, 1898, *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938, *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka, 1864), *Pseudotissotia galliennei* (d'Orbigny, 1850), *Collignoniceras woollgari* (Mantell, 1822) *sensu lato*, *Coilopoceras springeri* Hyatt, 1903, and *Eubostrychoceras* (*Eubostrychoceras*) *saxonicum* (Schlüter, 1872).

This is clearly an upper Middle Turonian assemblage, spanning the *deverianum* and *mexicanum* Zones, as indicated by the presence of their index species. The remaining elements are compatible with this assignation.

The highest fauna, from the Marnes supérieurs de Saint-Louis of the Saint-Louis syncline is: *Subprionocyclus* sp. juv., *Prionocyclus* sp. and *Worthoceras* cf. *rochatianum* (d'Orbigny, 1850). The *Subprionocyclus* are minute individuals that resemble *S. bravaisianus* (d'Orbigny, 1841), and suggest the presence of the lower Upper Turonian *bravaisianus* Zone on the basis of the sequence in the Uchaux Massif (Vaucluse) described by Robaszynski *et al*. (2014; Text-fig. 5).

ZONE	SUBSTAGE
Forresteria petrocoriensis	LOWER CONIACIAN
Prionocyclus germari	UPPER TURONIAN
Subprionocylus bravaisianus	
Romaniceras deverianum	
Romaniceras mexicanum	MIDDLE TURONIAN
Romaniceras ornatissimum	
Romaniceras kallesi	
Kamerunoceras turoniense	
Mammites nodosoides	LOWER TURONIAN
Fagesia catinus	
Watinoceras devonense	
Neocardioceras juddii	UPPER CENOMANIAN (part)
Metoicoceras geslinianum	

Text-fig. 5. The Upper Cenomanian, Turonian, and Lower Coniacian ammonite zonation for southern Europe, as proposed by Robaszynski and Amédro in Robaszynski et al. 2014 (Text-fig. 32)

CONVENTIONS

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

REPOSITORIES OF SPECIMENS

BMNH: The Natural History Museum, London.

FSIT: MB : Michel Bilotte Collection. A : Collection historique du Laboratoire de géologie. PM (BS/CT/DS/FR/LN/MC/MS/MSN/MSNP/MSSP/MT/PP): Collection Patrice Melchior. All of these collections are held in the réserves of the Service Commun d'Etudes et de Conservation des Collections Patrimoniales de la Faculté des Sciences et Ingénierie de Toulouse (formerly the Université Paul-Sabatier).

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

Sen. Senesse Collection, housed in the Université de Montpellier.

PIB: The Palaeontological Institute of Bonn University.

Order Ammonoidea Zittel, 884
Suborder Phylloceratina Arkell, 1950
Superfamily Phylloceratoidea Zittel, 1884
Subfamily Phylloceratinae Zittel, 1884
Genus *Phylloceras* Suess, 1866

TYPE SPECIES: *Ammonites heterophyllus* J. Sowerby, 1820, p. 119, pl. 226, by monotypy.

Subgenus *Hypophylloceras* Salfeld, 1924

TYPE SPECIES: *Phylloceras onoense* Stanton, 1895, p. 74, by monotypy.

Phylloceras (*Hypophylloceras*) *masiaposensis*
Collignon, 1956
(Text-figs 6; 16C, D)

1956. *Hyporbulites masiaposensis* Collignon, p. 18, pl. 1, fig. 7; text-fig. 3.
2009. *Hyporbulites masiaposensis* Collignon, 1956; Klein *et al*., p. 92 (with full synonymy).

TYPE: The holotype, by original designation, is MNHP R438, the original of Collignon 1956, p. 18, pl. 1, fig. 7, from the Turonian Zone à *Coilopoceras requieni* et *Romaniceras deveriai* of Masiaposa, Belo-sur-Tsiribihina, Madagascar.

MATERIAL: FSIT MSN23, from NE of Marsa (Padern area); FSIT DS8, from le Devès (Padern area).

DESCRIPTION: FSIT DS8 (Text-fig. 16C, D) is a fragment with a maximum preserved whorl height of 23.5 mm to the best-preserved sector, which retains well-preserved recrystallized shell. Coiling is very involute, the umbilicus tiny, with a flattened, outward-inclined wall, producing a conical circumbilical pit. The umbilical shoulder is very narrowly rounded. The whorl section is compressed, with a whorl breadth to height ratio of 0.68, the flanks flattened, the outer flanks feebly convergent, the ventrolateral shoulders broadly rounded, the venter feebly convex. The inner flanks are smooth. The outer flanks, ventrolateral shoulders and venter are ornamented by very fine ribs, feebly convex on the inner part of the outer flank, strengthened, and recti- to feebly rursirsdiate on the outer flank, and transverse across the venter, where they reach their greatest strength. They are separated by slightly wider interspaces that increase in width across the flanks and ventrolateral shoulder.

FSIT MSN23 (Text-fig. 6) has a maximum preserved diameter of 118 mm and is part body chamber, although the position of the final septum cannot be established. It retains extensive areas of replaced and part limonitised shell. Coiling is very involute, the tiny umbilicus surrounded by a flattened wall, producing a conical circumbilical pit, as in the previous specimen. The umbilical shoulder is quite narrowly rounded. The whorl breadth to height ratio is 0.62, the greatest breadth below mid-flank, the flanks flattened, the outer flanks converging to the broadly rounded ventrolateral shoulders and venter. Where replaced shell is preserved, the inner flanks are near-smooth, but for deli-

Text-fig. 6. *Phylloceras* (*Hypophylloceras*) *masiaposensis* Collignon, 1956, FSIT MSN23, from NE of Marsa (Padern area). Figures are × 1

cate lirae; these strengthen into fine ribs on the inner part of the outer flanks, where they are concave, becoming straight to feebly rursiradiate on the outer flanks. They strengthen progressively across the ventrolateral shoulders, and are straight and transverse across the venter. They are separated by slightly wider interspaces, the relative width increasing across the flanks and ventrolateral

DISCUSSION: Phylloceratids are exceedingly rare in the Turonian of Western Europe. *Phylloceras* (*Hypophylloceras*) *bizonatum* Fritsch, 1872 (p. 40, pl. 14, fig. 7) is a very compressed, flat-sided species known from The Czech Republic and, possibly, the Middle and Upper Turonian of the Münster Basin, Germany (the *Phylloceras* (*Hypophylloceras*) sp. of Lehmann 1995, p. 402, text-figs 2, 3).

Wiese (1995, pl. 2, fig. 5; 1997, pl. 2, fig. 4) figured a worn and specifically indeterminate *Phylloceras* (*Hypophylloceras*) from the Middle Turonian *Romaniceras kallesi* Zone of Cantabria.

OCCURRENCE: As for material.

Suborder Lytoceratina Hyatt, 1889
Superfamily Tetragonitoidea Hyatt, 1900
Family Tetragonitidae Hyatt, 1900
Genus *Tetragonites* Kossmat, 1895
(= *Epigoniceras* Spath, 1925; *Carinites* Wiedmann, 1973)

TYPE SPECIES: *Ammonites timotheanus* Pictet, 1847, p. 295, pl. 2, fig. 6; pl. 3, fig. 1; by original designation.

Tetragonites epigonus (Kossmat, 1895)
(Text-fig. 7A, B)

1895. *Lytoceras* (*Tetragonites*) *epigonus* Kossmat, p. 135 (39), pl. 17 (3), figs 4, 5, 10.
2009. *Tetragonites epigonus* (Kossmat, 1895); Klein *et al*., p. 232 (with full synonymy).

TYPE: The lectotype, by the subsequent designation of Kennedy and Klinger, 1977 (p. 166), is the original of Kossmat 1895, pl. 17 (3), fig. 4, from the upper part of the Trichinopoly Group of Varagur, South India.

MATERIAL: FSIT MB MAT, from the Cascade des Mathieux (Saint-Louis syncline).

DESCRIPTION: The specimen has a maximum preserved diameter of 67 mm, and retains recrystallized shell on the surviving flank. Coiling is involute, with 64% of the previous whorl covered. The umbilicus comprises 30.4% of the diameter, and is of moderate depth, with a convex, outward-inclined wall and broadly rounded umbilical shoulder. The whorl section appears to have been depressed, with feebly convex flanks, broadly rounded ventrolateral shoulders and venter. The surface of the shell is poorly preserved, but towards the adapical end of the outer whorl, a single coarse, rounded collar rib is preserved on the adapical side of a weak constriction. This collar rib is convex across the ventrolateral shoulder, and feebly concave across the venter.

OCCURRENCE: Turonian to Campanian, the southern Corbières, Aude in France (in both the Turonian and Santonian), northern Spain, Romania, Algeria, Central Tunisia, Angola, Eastern Cape Province and KwaZulu-Natal in South Africa, Madagascar, South India, Japan, Sakhalin, British Columbia, South Patagonia in Chile and the Antarctic Peninsula.

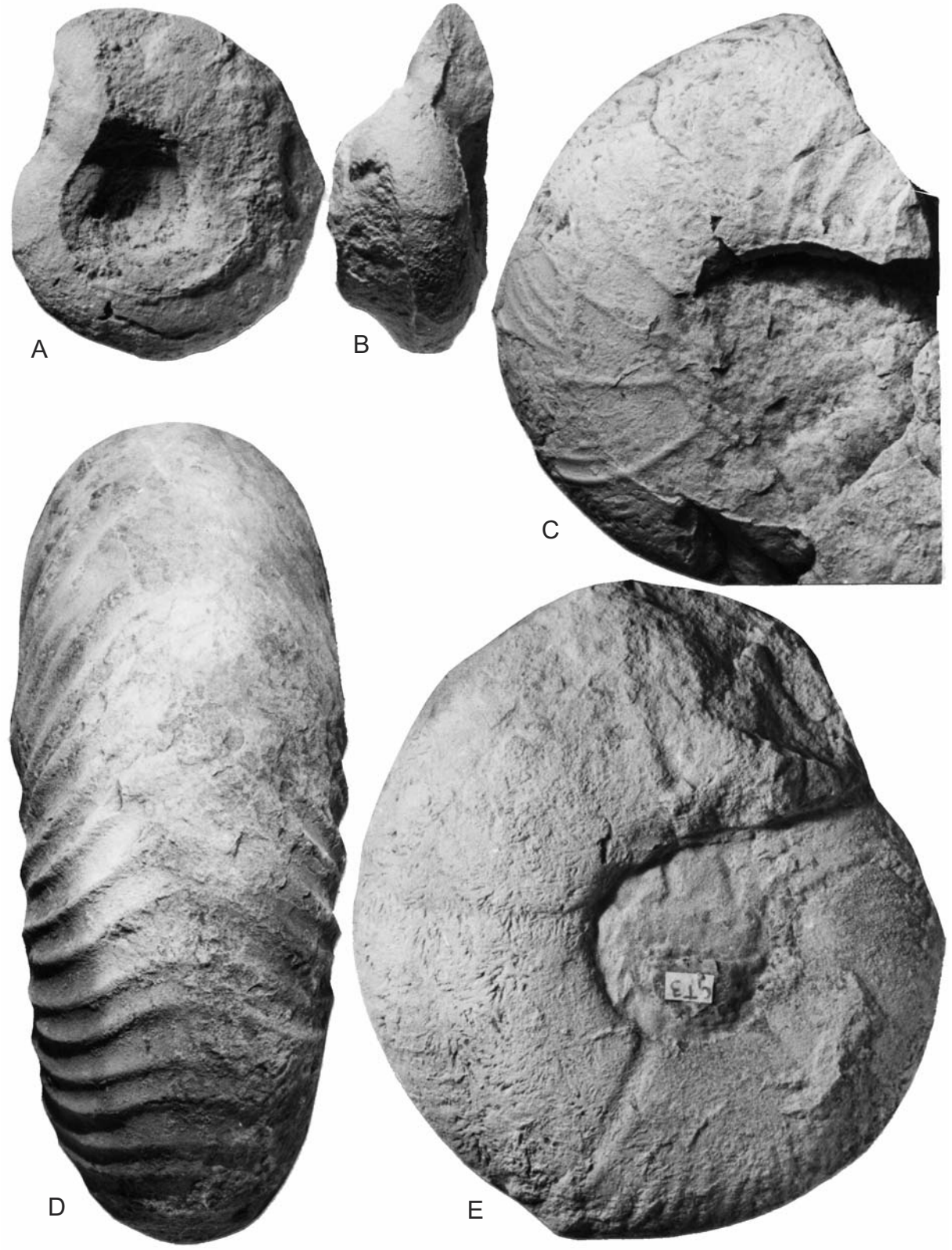
Suborder Ammonitina Hyatt, 1889
Superfamily Desmoceratoidea Zittel, 1895
Family Desmoceratidae Zittel, 1895
Subfamily Puzosiinae Spath, 1922
Genus and subgenus *Puzosia* Bayle, 1878

TYPE SPECIES: *Ammonites planulatus* J. de C. Sowerby, 1827 p. 134, pl. 570, fig. 5, *non* Schlotheim, 1820, p. 59; = *Ammonites mayorianus* d'Orbigny, 1841, p. 267, pl. 79, figs 1–3, by subsequent designation by H. Douvillé, 1879, p. 91.

Puzosia (*Puzosia*) *mulleri* de Grossouvre, 1894
(Text-fig. 9)

1872. *Ammonites hernensis* Schlüter, p. 40, pl. 11, figs 12–14.
1894. *Puzosia Mülleri* de Grossouvre, p. 172.
1994. *Puzosia* (*Puzosia*) *mulleri* de Grossouvre, 1894; Kaplan and Kennedy, p. 34, pl. 1, figs 1–3; pl. 2, figs 1, 6; pl. 3 (with synonymy).

TYPE: The lectotype of *Puzosia mulleri* de Grossouvre, 1894, by the subsequent designation of Kaplan and Kennedy 1994, p. 34, is PIB Schlüter Collection 41, the original of Schlüter 1872, pl. 11, figs 12, 13, from the 'Cuvieri Planer'of Rothenfelde, Lower Saxony, Germany. It was refigured by Kaplan and Kennedy, 1994, pl. 1, fig. 2.



Text-fig. 7. A, B – *Tetragonites epigonus* Kossmat, 1894, FSIT MAT, from the Cascade des Mathieux (Saint-Louis syncline). C, D – *Pachydesmoceras kossmati* Matsumoto, 1987. C – FSIT MC19, from Marnes supérieures de Saint-Louis (Saint-Louis syncline). D – FSIT MB 581, from the Cascade des Mathieux (Saint-Louis syncline) (see also Text-fig. 12). E – *Puzosia* cf. *intermedia* Kossmat, 1898, FSIT CT3, from Les Capitaines. Figures A–C, E, are x1; Fig. D is reduced × 0.6

MATERIAL: FSIT DS3, from le Devès (Padern area); MC22, from the Saint-Louis syncline; PJ1, from Les Capitaines; DS1, from le Devès (Padern area); and MC14, from le Trou des Sorcières (Saint-Louis syncline).

DESCRIPTION: FSIT DS3 is a fragmentary nucleus retaining recrystallized shell, a 180° sector of penultimate whorl 21.6 mm in diameter, and a 120° sector of the succeeding whorl with a maximum preserved whorl height of 15.3 mm. Coiling is very evolute, with 43% of the previous whorl covered. The umbilicus is shallow, with a flattened, subvertical wall and narrowly rounded umbilical shoulder. The whorl section is very compressed, with flat subparallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. The flanks of the penultimate whorl, so far as they are visible, are smooth, but for slight indications of a single constriction that is feebly convex on the inner flank. The corroded surface of the outer whorl has smooth inner flanks and traces of fine ribs on the outer flanks, concave on the ventrolateral shoulder, and crossing the venter in a broad convexity. FSIT DS1 is an internal mould of a nucleus with an estimated original diameter of 70 mm, and part of the succeeding whorl. Coiling is very involute, the umbilicus comprising 36.5% of the diameter, shallow, the whorl proportions as in the previous specimen .The inner flanks are smooth, but for indications of a single feeble constriction. The outer flanks, ventrolateral shoulders and venter bear fine ribs at the greatest preserved diameter; strengthening progressively, they are concave on the outermost flank and ventrolateral shoulder and cross the venter in a broad convexity. Parts of the outer whorl are preserved, with a maximum whorl height of 50 mm; no ornament survives. FSIT PJ1 (Text-fig. 9) is a wholly septate internal mould comprising a nucleus an estimated 90 mm in diameter and a 120° sector of the succeeding whorl, with a maximum preserved whorl height of 60 mm. Coiling and proportions are consistent with the smaller specimens; the whorl breath to height ratio is 0.56. The surface is poorly preserved, but fine ribbing is present on the ventrolateral shoulders and venter, as in the previous specimens.

DISCUSSION: Compressed whorls, evolute coiling and shallow umbilicus distinguish this species from all other *Puzosia* recorded from Western Europe, including *Puzosia* (*Puzosia*) cf. *intermedia* Kossmat, 1898, described below.

OCCURRENCE: Upper Turonian and Lower Coniacian of the Münster Basin in Germany, and the Lower and Middle Turonian of the southern Corbières, Aude, France.

Puzosia (*Puzosia*) cf. *intermedia* Kossmat, 1898
(Text-figs 7E; 8)

1898. *Puzosia Gaudama* var. *intermedia* Kossmat, p. 181 (116), pl. 23 (17), fig. 3.
2011. *Puzosia* (*Puzosia*) *intermedia* Kossmat, 1898; Klein and Vašiček, p. 75 (with full synonymy).

TYPE: The holotype, by monotypy, is the original of *Puzosia Gaudama* var. *intermedia* Kossmat, 1898, p. 181 (116), pl. 23 (17), fig. 3, from the Trichinopoly Group near Garudamungalum, South India.

MATERIAL: FSIT CT3, from Les Capitaines; FSIT MB 697, from Calcaires de Montplaisir (Saint-Louis syncline).

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
FSIT CT3	120.5(100)	39.0(32.4)	53.7(44.6)	0.73	32.6(27.1)

DESCRIPTION: FSIT CT3(Text-fig. 7E) is an internal mould of a phragmocone with a maximum preserved diameter of 124 mm. Coiling is moderately involute, the umbilicus shallow, with a low, flattened wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.73, the greatest breadth below mid-flank. The inner flanks are very feebly convex, the outer flanks converging to the broadly rounded ventrolateral shoulders and venter. There are five constrictions visible on the outer whorl, and an estimated six in all. They are deeply incised into the umbilical shoulder, quite broad and straight on the inner flanks, flexing forwards and concave on the outer flanks and ventrolateral shoulder and sweeping forwards to form an obtuse chevron with a narrow linguoid peak on the venter. Delicate inner flank ribs are present on the the adapical part of the outer whorl. They are straight on the innermost flank, strengthening markedly, and concave on the outer flank and ventrolateral shoulder, where there are 18–20 between successive constrictions. The adapical side of the constrictions is marked by a feeble collar rib.

FSIT MB 697 (Text-fig. 8), from the "base du Calcaire de Montplaisir à l'est de Paradou Petit", is a worn internal mould with a maximum preserved diameter of 140 mm. The umbilicus comprises an estimated 32% of the diameter. The umbilical wall is narrowly rounded, the whorl section compressed, with flattened subparallel flanks and a narrow, arched venter. There are four prominent constrictions in a 300° sector of the outer whorl. They are strong and deep, broad, straight and prorsirsdiate on the flanks, projecting forwards on the

Text-fig. 8. *Puzosia* (*Puzosia*) cf. *intermedia* Kossmat, 1898, FSIT MB 697, from the base of the Calcaires de Montferrand, east of Parahou Petit (Saint-Louis syncline), × 1

ventrolateral shoulder, where they are weaker, forming a narrow ventral chevron with a rounded peak. There are very feeble ribs on the inner flank that strengthen markedly on the outer, where they are relatively coarse, markedly concave on the outermost flank and ventrolateral shoulder, across which they strengthen progressively, and cross the venter in a broad linguioid peak. There are an estimated 14 between successive constrictions at the ventrolateral shoulder.

DISCUSSION: The specimens are compared to *Puzosia* (*P*.) *intermedia* on the basis of relative proportions, spacing of constrictions, rib form and density.

OCCURRENCE: As for material.

Genus *Pachydesmoceras* Spath, 1922

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

Pachydemoceras kossmati Matsumoto, 1987
(Text-figs 7D; 10A–C, E, H–L; 11A–D; 12)

1865. *Ammonites denisonianus* Stoliczka, p. 153 (*pars*), pl. 66, fig. 2.

1898. *Desmoceras* (*Puzosia*) *Denisoniana* Stoliczka sp.; Kossmat, p. 121 (186), pl. 14 (20), fig. 6, pl. 15 (21), fig. 5.

Text-fig. 9. *Puzosia mulleri* de Grossouvre, 1994, FSIT PJ1, from Les Capitaines, × 1

1922. *Pachydesmoceras denisonianum* (Stoliczka); Spath, p. 127.
1987. *Pachydesmoceras kossmati* Matsumoto, p. 6, Text-fig. 1.
1988. *Pachydesmoceras kossmati* Matsumoto, 1987; Matsumoto *et al*., *in* Matsumoto, 1988 p. 116, text-figs 50–54.
2013. *Pachydesmoceras kossmati* (Matsumoto, 1987); Kennedy *et al*., p. 630, pl. 1, fig. 6; text-fig. 3.

TYPE: The holotype, by the original designation of Matsumoto, 1987, p. 6, is the original of *Desmoceras* (*Puzosia*) *Denisoniana* Stoliczka sp. of Kossmat 1898, p. 121 (186), pl. 14 (21), fig. 6, pl. 15 (21), fig. 5, a specimen in the collections of the Geological Survey of India, from the brown calcareous concretions in the Utatur Group of Odium, Tamil Nadu, south India. It is imprecisely dated in the Cenomanian–Turonian interval. There are a number of paratypes, as listed by Matsumoto (1987) and Matsumoto *et al*., *in* Matsumoto (1988).

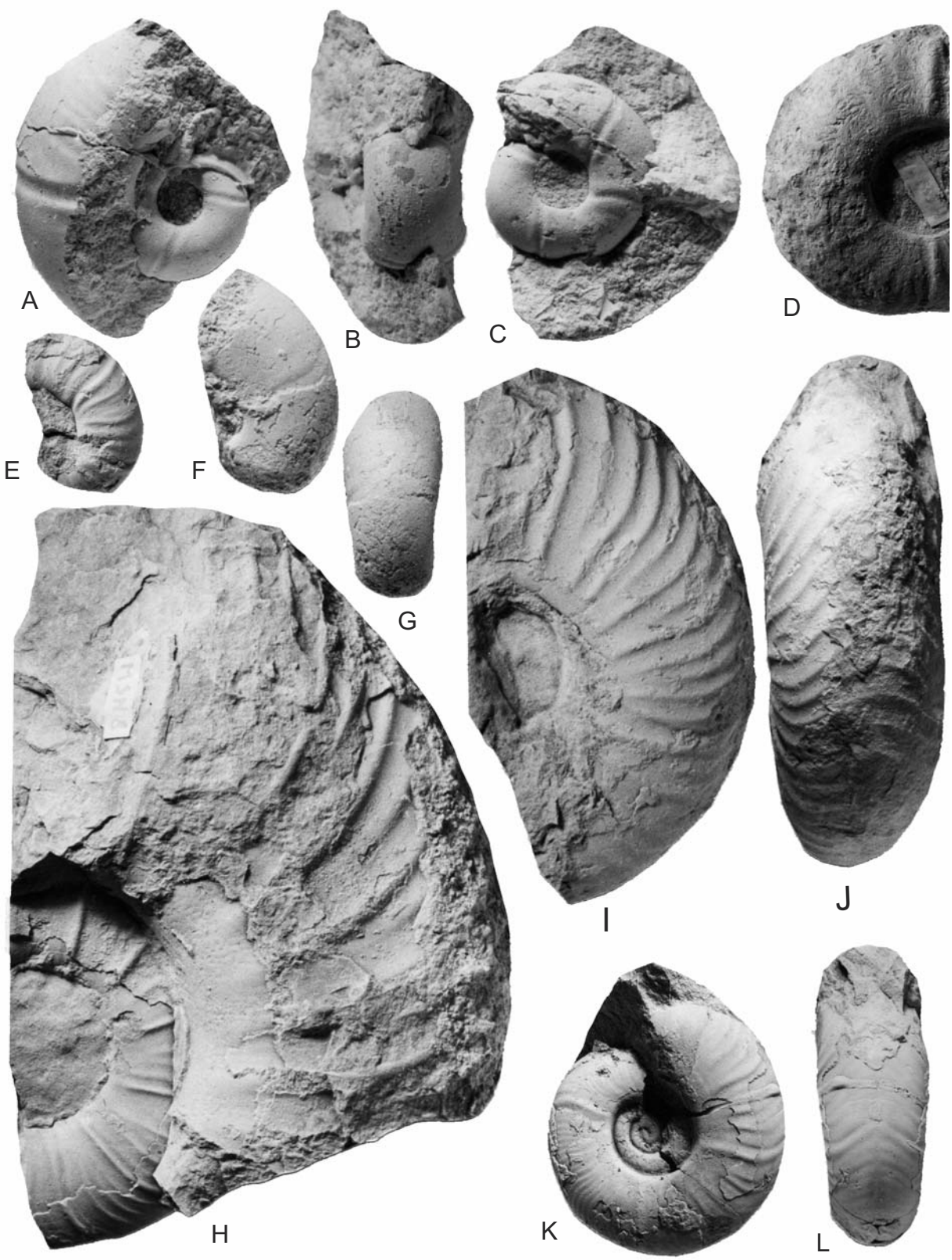
MATERIAL: DS5, DS6, from le Devès (Padern area);

MSN 7, 8, 18, 19, 21, 25, 26, 27, from the Padern area; M9, from Baillesats; MC19, 21, from the Saint-Louis syncline; FSIT MB 581 from Cascade des Mathieux.

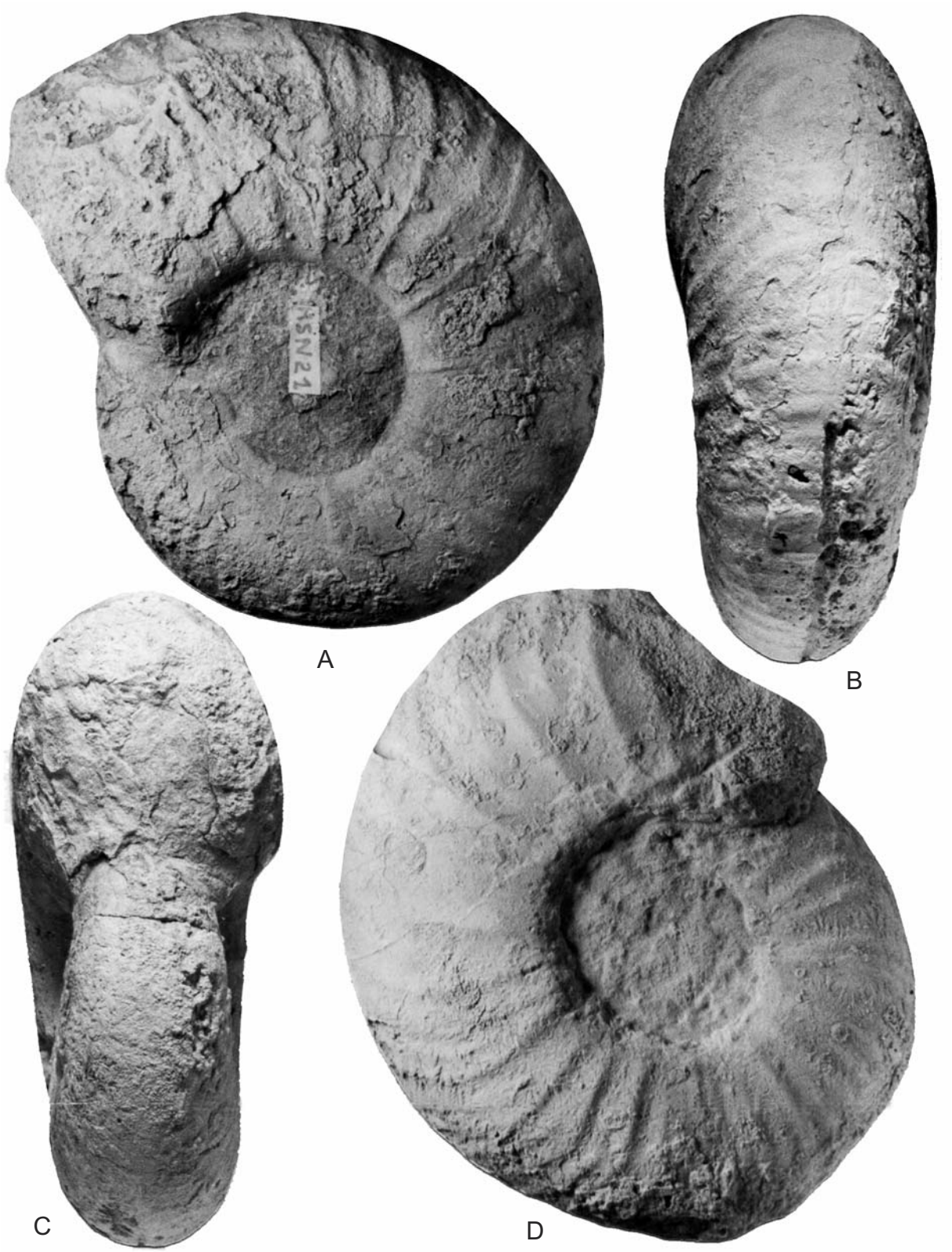
DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
MSN26	46.3(100)	20.9(45.1)	20.3(43.8)	1.03	15.1(32.6)
MSN8	92.2(100)	32.6(35.4)	38.8(42.1)	0.84	24.8(27.0)
MSN21	123.0	~47.7(38.8)	54.0(43.9)	~0.88	37.2(30.2)

DESCRIPTION: FSIT DS6 (Text-fig. 10A–C) is a calcite filled nucleus 12 mm in diameter. Coiling is involute, the deep umbilicus comprising an estimated 28% of the diameter, with a feebly convex wall and broadly rounded umbilical shoulder. The whorl section is depressed reniform, with the greatest breadth below midflank. There are four strong constrictions on the 300° sector of the penultimate whorl. They are deeply incised into the umbilical wall and shoulder, prorsiradiate and very feebly sinuous across the flanks: convex on the inner flank and concave on the outer flank. They weaken on the ventrolateral shoulders and venter, which they cross in a very feeble convexity. The constrictions are flanked by a strong adapical and weaker adapertural collar rib. FSIT DS5 (Text-fig. 10E) is a 33 mm long 120° whorl sector. Sixteen well-developed ribs are present. Primaries arise at the umbilical seam and strengthen across the umbilical wall and shoulder. They are flexuous and prorsirsdiate on the flanks, across which they strengthening progressively, convex on the inner flank and concave on the outer flank before sweeping forwards and weakening across the ventrolateral shoulder and crossing the venter in a very obtuse linguoid peak. There are occasional weak intercalated ribs. Two constrictions are present on the fragment, with well-developed adapical and adapertural collar ribs. FSIT MSN26 (Text-fig. 10K, L) is a beautifully preserved nucleus 48 mm in diameter, with recrystallized shell preserved. Coiling is moderately involute, the umbilicus comprising 32.6% of the diameter, of moderate depth, with a flattened, outward-inclined wall and narrowly rounded umbilical shoulder. The whorl section is very slightly depressed, with very feebly convex subparallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. There are an estimated six constrictions on the outer whorl. They are flexuous and recti- to feebly prorsirdiate on the flanks, very feebly convex on the inner flank and very feebly concave on the outer flank, projecting forwards on the ventrolateral shoulders, where they weaken and cross the venter in an obtuse linguoid peak. There are strong adapical and weaker adapertural collar ribs. On the adapical part of the outer whorl, successive collar ribs are separated by more than 20 crowded delicate ribs that are very weak on the innermost flank but strengthen across the flanks, ventrolateral shoulders and venter. They are prorsirsdiate, feebly convex on the inner flank and feebly concave on the outer, project strongly forwards on the ventrolateral shoulder and cross the venter in an obtuse linguoid peak. On the adapertural part of the outer whorl the ribs coarsen and the number between successive collar ribs is reduced to as few as four. FSIT MSN8 (Text-fig. 10H) continues the ontogeny. The penultimate whorl is 92.2 mm in diameter. There are seven strong narrow primary ribs per half whorl, straight to very feebly convex on the inner flank and feebly concave on the outer, projecting strongly forwards and concave on the ventrolateral shoulder, and crossing the venter in a broad convexity. In most cases these are the adapical collar rib of progressively weakening constrictions. Much weaker ribs arise either singly or in pairs at the umbilical shoulder, with two to four between successive collar ribs, the number decreasing as size increases. The outer whorl of this specimen shows a change to the succeeding ontogenetic stage. Numerous primary ribs arise on the umbilical wall, where they are very weak, strengthening markedly on the umbilical shoulder. They are coarse, straight, and markedly prorsiradiate on the inner to middle flank, projecting forwards and markedly concave on the outer flank and ventrolatral shoulder, strengthening progressively, and crossing the venter in a broad convexity. The primary ribs are separated by a single long intercalated rib that arises low on the flank and strengthens to match the primaries on the outer flank, ventrolateral shoulders and venter. FSIT M8 (Text-fig. 10 I, J) is a smaller but very well-preserved phragmocone fragment with a maximum preserved diameter of 100 mm. There are 24 ribs at the ventrolateral shoulder, primaries and single intercalated ribs alternating regularly. FSIT MSN21 (Text-fig. 11A, B) has 24 ribs on the adapertural half whorl at a diameter of 123 mm, primary and single intercalated ribs alternating regularly; there are no clearly developed constrictions. FSIT M9 (Text-fig. 11C, D) is comparable, a 124 mm diameter phragmocone with traces of a constriction at the adapical end of the outer whorl; the ornament is as in the previous specimen, with 14 primary ribs and a total of 26–28 ribs per whorl at the ventrolateral shoulder. FSIT MSN7 has three constrictions on the outer whorl at a diameter of 150 mm. FSIT MC21, 120 mm in diameter, and FSIT MC19, 150 mm in diameter, show the transition from collar ribs and associated constrictions separated by weaker ribs to a regular alternation of single primary and intercalated ribs, the latter at a diameter of 102 mm; the transition between the two growth stages thus



Text-fig. 10. A-C, E, H-L – *Pachydesmoceras kossmati* Matsumoto, 1987. A-C – FSIT DS6, from le Devès (Padern area); E – FSIT DS5, also from le Devès; H – FSIT MSN8, from NE of Marsa (Padern area); I, J – FSIT M8, from east of Marsa; K, L, FSIT MSN26, from NE of Marsa. D – *Tongoboryceras* sp., FSIT MSN 17, from NE of Marsa. F, G – *Desmoceras* (*Pseudouhligella*) sp., FSIT MT3, from the Calcaire de Montplaisir (Saint-Louis syncline). Figures A-C are × 3; Figs D, E, H-L are × 1; Figs F, G, are × 2



Text-fig. 11. *Pachydesmoceras kossmati* Matsumoto, 1987. A, B – FSIT MSN21, from NE of Marsa (Padern area); C, D – FSIT M9, from Baillesats. All figures are × 1

occurring at varying diameters. The largest specimen seen, FSIT MB581 (Text-figs 7D; 12) is 250 mm in diameter, in part body chamber. The pattern of regularly alternating prorsiradiate primary and single intercalated ribs, concave and strongly projected on the ventolateral shoulders, extends onto the adapical part of the body chamber. On the adapertural 120° sector of the body chamber, all of the ribs are primaries, those closest to the aperture weakening, suggesting the specimen to be a complete adult.

DISCUSSION: See Matsumoto *et al.* (*in* Matsumoto, 1988) and Kennedy *et al.* (2013).

OCCURRENCE: Lower and Middle Cenomanian of Madagascar, Cenomanian or Turonian of south India,

Text-fig. 12. *Pachydesmoceras kossmati* Matsumoto, 1987, FSIT MB 581, from the Cascade des Mathieux (see also Text-fig. 7D). Reduced × 0.7; the original is 250 mm in diameter

Lower and Middle Turonian of Japan. Lower and Middle Turonian of the southern Corbières, Aude, France.

Pachydesmoceras linderi (de Grossouvre, 1894)
(Text-figs 13, 14)

1894. *Pachydiscus linderi* de Grossouvre, p. 188 (*pars*), pl. 18, *non* pl. 24, fig. 4.
1991. *Pachydesmoceras linderi* (de Grossouvre, 1894); Cobban and Kennedy, p. A2, pl. 1 (with synonymy).
2011. *Pachydesmoceras linderi* (de Grossouvre, 1894); Klein and Vašiček, p. 99 (with additional synonymy).
non 2014. *Pachydesmoceras linderi* de Grossouvre; Amédro and Devalque *in* Robaszynski *et al.*, p. 132, pl. 11, fig. 1 (=*Pachydesmoceras* sp.)

TYPE: The holotype, by original designation, is MNHP R51861, the original of de Grossouvre, 1894, p. 188, pl. 18 (Text-fig. 13 herein). De Grossouvre described it as being from the "partie inférieur de l'étage sénonien. Environs de Padern (Aude)." The age is in fact Turonian, as clarified by Roussel (1895). The original of de Grossouvre, 1895, pl. 24, fig. 4, is a paratype. It is from the Marnes à *Micraster* of Bugarach (Aude), and is from the Santonian, as noted by De Grossouvre (1901, p. 443, footnote 3). It belongs to some other species.

MATERIAL: FSIT M9, from Baillesats. FSIT MSN27, from NE of Marsa (Padern area).UM Sen. 021, from between Parahou Petit and Monié in the Saint-Louis syncline.

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
MNHP R51861	210(100)	~50(24)	86(41)	~0.58	61(29.0)

DESCRIPTION: The holotype has a maximum preserved diameter of 210 mm, and retains recrystallized shell. The whorl section is compressed ovoid, with a whorl breadth to height ratio of 0.58 approximately. The shallow umbilicus comprises 29% approximately of the diameter, the umbilical wall low and flattened, the umbilical shoulder quite broadly rounded. There are an estimated 28–29 narrow, strong primary ribs per whorl. They arise on the umbilical shoulder, without developing into bullae, and are straight and feebly prorsirdiate on the inner and middle flank, flexing forwards and concave across the outer flank and ventrolateral shoulder, and crossing the venter near-transverse. On the adapical half of the outer whorl, one long and one short rib intercalate between successive primaries; on the adapertural half, a single short rib intercalates. The intercalated ribs strengthen to match the primaries on ventrolateral shoulders and venter, where the rib total is an estimated 65 per whorl. FSIT MSN27 (Text-fig.14) is a slightly crushed individual retaining recrystallised shell, and is 205 mm in diameter. There are indications of the former presence of a further 240° whorl sector. Preservation apart, it differs in no significant respects from the holotype.

DISCUSSION: Cobban and Kennedy (1991, p. A2) discuss differences from other species. When compared to *Pachydesmoceras kossmati*, described above, the present species is much more compressed, with single very short intercalated ribs between successive primaries throughout the known ontogeny, the ribs less markedly projected on the outermost flank and ventrolateral shoulder.

OCCURRENCE: Lower and Middle Turonian of the Corbières, Aude, France Upper Turonian of Romania, Morocco, Madagascar, and Colorado in the United States. Also recorded from Santa Cruz Province, Argentina.

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

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

Subgenus *Pseudouhligella* Matsumoto, 1938

TYPE SPECIES: *Desmoceras dawsoni* var. *japonica* Yabe, 1904, p. 35, pl. 5, fig. 3, by the subsequent designation of Matsumoto, 1938, p. 22.

Desmoceras (*Pseudouhligella*) sp.
(Text-fig. 10F, G)

MATERIAL: FSIT MT3, from the Calcaires de Montplaisir of the Saint-Louis syncline.

DESCRIPTION: The specimen is a 120° sector of phragmocone with a maximum preserved whorl height of 12 mm. Coiling is very involute, with a tiny, deep umbilicus and narrowly rounded umbilical shoulder. The

flanks are flattened and subparallel, the ventrolateral shoulders broadly rounded, the venter very feebly convex. The whorl breadth to height ratio is 0.97. The surface of the internal mould is smooth, but for a single constriction, feebly convex at mid-flank, feebly concave on the outer flank, projecting forwards on the ventrolateral shoulders, declining and effacing on the venter. The sutures are not seen.

DISCUSSION: Small size and lack of sufficient diagnostic features preclude specific identification, but allow assignation to *Desmoceras* (*Pseudouhligella*) on the basis of features shared with other members of the subgenus.

OCCURRENCE: As for material.

Family Pachydiscidae Spath, 1922
Genus *Tongoboryceras* Houša, 1967

TYPE SPECIES: *Lewesiceras tongoboryense* Collignon, 1952, p. 23, pl. 2, fig. 3, by the original designation of Houša, 1967, p. 42.

Text-fig. 13. *Pachdesmoceras linderi* (de Grossouvre, 1894), the lectotype, MNHP R51861, the original of de Grossouvre, 1894, pl. 18, from the environs of Padern. The figure is reduced × 0.8 approximately

Text-fig. 14. *Pachdesmoceras linderi* (de Grossouvre, 1894), FSIT MSN27, from NE of Marsa (Padern area). The figure is × 1

Tongoboryceras sp.
(Text-fig. 10D)

MATERIAL: FSIT MSN17, from NE of Marsa (Padern area).

DESCRIPTION: The specimen is a 180° sector of an internal mould with a maximum preserved diameter of 57 mm. Coiling is moderately evolute, the umbilicus comprising an estimated 38% of the diameter, of moderate depth, with a convex, outward-inclined wall and broadly rounded umbilical shoulder. The whorl section is as wide as high, with the maximum breadth around mid–flank, the flanks feebly convex, the ventrolateral shoulders and venter broadly rounded. Ornament is poorly preserved. Primary ribs arise either singly or in pairs on the umbilical wall, and strengthen across the umbilical wall and shoulder. They are narrow, straight, recti- to feebly prorsiradiate on the flanks, flexing forwards and concave on the ventrolateral shoulders, and crossing the venter in a broad convexity. One or more ribs intercalate between successive primaries on the mid–flank region. Two strong constrictions are present on the fragment, close to the adapical and adapertural ends. There are indications of two or three more, but preservation is poor. The well-preserved constrictions are preceded by a strong collar rib, that is incipiently bullate at the adapical end of the fragment.

DISCUSSION: Ornament indicates this specimen to be a *Tongoboryceras*, comparable to *T. rhodanicum* (Roman and Mazeran, 1913) (p. 18, pl. 1, fig. 10; see revisions in Wright, 1979, p. 316, pl. 6, fig. 1; Amédro *in* Robaszynski *et al*., 2014, p. 134, pl. 34, fig. 2).

OCCURRENCE: As for material.

Superfamily Acanthoceratoidea de Grossouvre, 1894
Family Acanthoceratidae de Grossouvre, 1894
Subfamily Euomphaloceratinae Cooper, 1978

Genus *Kamerunoceras* Reyment, 1954a
(=*Schindewolfites* Wiedmann, 1960, p. 763;
Polyaspidoceras Matsumoto, 1978, p. 18)

TYPE SPECIES: *Kamerunoceras eschii* Solger, 1904, p. 124, pl. 4, figs 1–4, by the original designation of Reyment, 1954a, p. 250.

Kamerunoceras turoniense (d'Orbigny, 1850)
(Text-fig. 15M, N)

1850. *Ammonites turoniensis* d'Orbigny, p. 190.
1979a. *Kamerunoceras turoniense* (d'Orbigny); Kennedy and Wright, p. 1170, pl. 2, figs 1–11; pl. 3, figs 1, 2; pl. 4, figs 1–3; text-figs 2, 3 (with synonymy).
2007. *Kamerunoceras turoniense* (d'Orbigny); Barroso-Barcenilla, p. 153, pl. 12, figs d, e; pl. 13, figs a–f (with additional synonymy).
2009. *Kamerunoceras turoniense* (d'Orbigny, 1850); Amédro, text-fig. 4.
2010. *Kamerunoceras turoniense* (d'Orbigny, 1850); Nagm *et al*., p. 479, text-figs 6a–f, 7d–e.
2014. *Kamerunoceras turoniense* (d'Orbigny, 1850); Amédro and Devalque *in* Robaszynski *et al*., p. 138, pl. 14, fig. 2.

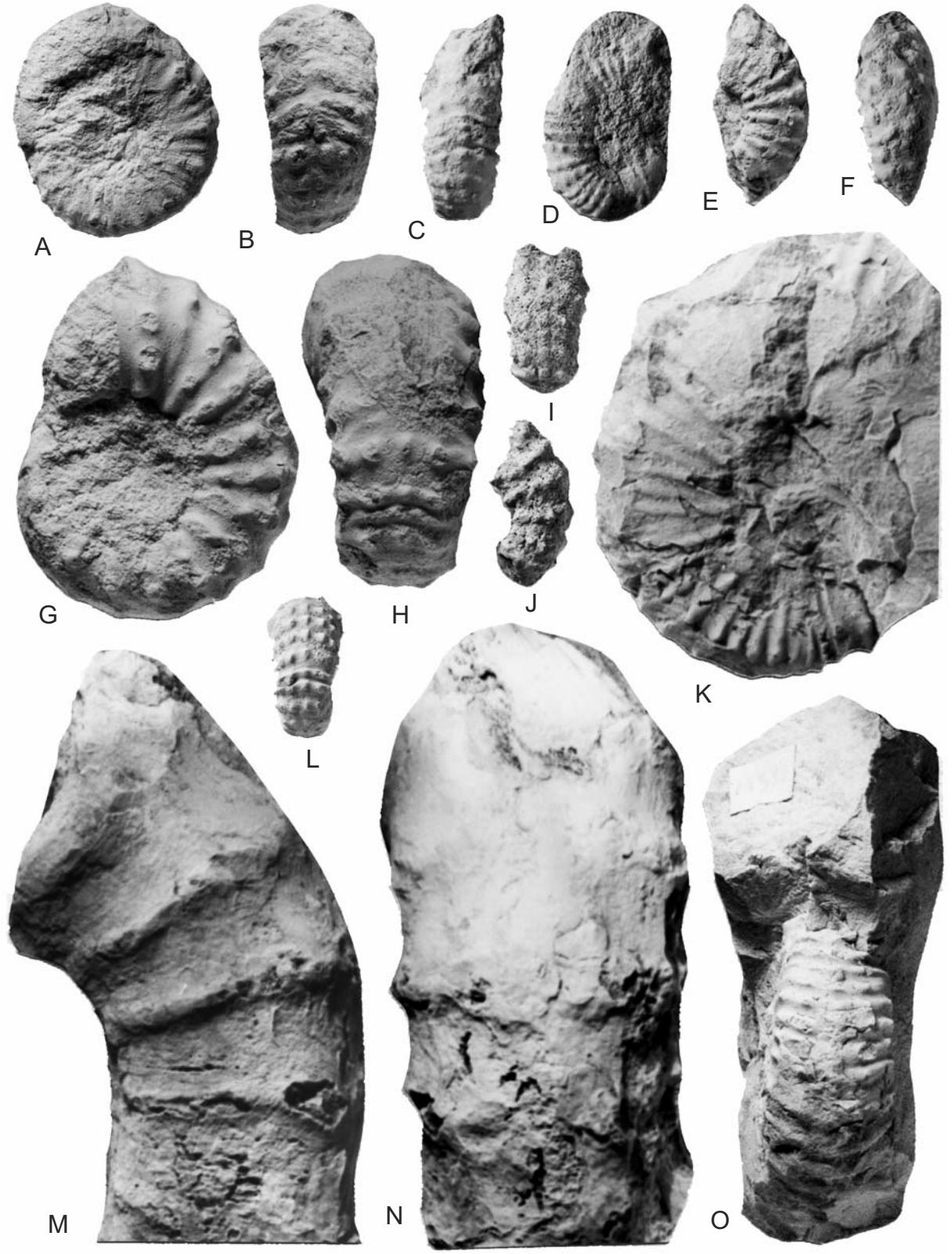
TYPE: Lectotype, by the subsequent designation of Kennedy and Wright, 1979, p. 1173, is MNHP6785 in the d'Orbigny Collection, from the Turonian of Tourtenay, Deux Sèvres, France, figured by Kennedy and Wright, 1979, pl. 3.

MATERIAL: FSIT FR8 and FR12, from La Ferrière (Padern area); MC1, from the Saint-Louis syncline; MSN19, from NE of Marsa (Padern area).

DESCRIPTION: The species is represented by a series of worn fragments and individuals. FSIT MC1 is a phragmocone 102 mm in diameter. Coiling is very evolute, the broad and shallow umbilicus comprising 38% of the diameter. The whorls expand slowly; the whorl section is slightly depressed. Ornament is of distant narrow ribs that arise at the umbilical seam and sweep back across the umbilical shoulder and strengthen into small umbilical bullae. The ribs are strong, narrow, and widely separated on the flanks, straight and recti- to feebly rursiradiate, with small lateral bullae, small conical inner ventrolateral tubercles and outer ventrolateral clavi. There are prominent siphonal clavi, linked by a low siphonal ridge. The largest fragment, FSIT FR9, has a whorl height of 55 mm, corresponding to an estimated diameter of 120 mm. Six narrow, distant ribs are present, with prominent umbilical and lateral bullae, rounded to subspinose inner ventrolateral tubercles, well-developed outer ventrolateral clavi, and a pronounced siphonal ridge.

DISCUSSION: The material, although poor is very typical. The species is comprehensively reviewed by Kennedy and Wright (1979a), Chancellor *et al*. (1994) and Barroso-Barcenilla (2007).

OCCURRENCE: Upper Lower and lower Middle Turonian, southern England, Touraine, Vaucluse, and the



Text-fig. 15. A, B – *Kamerunoceras douvillei* (Pervinquière, 1907), FSIT MSN19, from NE of Marsa (Padern area).C-J, L – *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka, 1865). C, D – FSIT 3b/4; E, F – FSIT 3b/3; I, J, 3b/1, all from the Calcaires de Montplaisir (Saint-Louis syncline); G, H – FSIT MT1, from the Calcaires de Montplaisir (Saint-Louis syncline). K, O – *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938. K, O – FSIT MS1, from NW Marsa. M, N – *Kamerunoceras turoniense* (d'Orbigny, 1850), FSIT FR9, from La Ferrière (Padern area). Figures A-F, I, O, are × 1; Figs G, H, are × 2; Figs M, N, are × 0.8

southern Corbières in France, Spain, Tunisia, Lebanon, Israel, Colorado and New Mexico in the United States.

Kamerunoceras douvillei (Pervinquière, 1907)
(Text-fig. 15A, B)

1907. *Acanthoceras douvillei* Pervinquière, p. 274, pl. 12, figs 2, 3.
1994. *Kamerunoceras douvillei* (Pervinquière, 1907); Chancellor *et al*., p. 28, pl. 6, figs 1–4; pl. 12, figs 4, 5 (with synonymy).

TYPE: The holotype, by original designation, is MNHP F–A25623, the original of Pervinquière, 1907, p. 274, pl. 12, fig. 3, refigured by Chancellor *et al*., 1994, pl. 12, figs 4, 5, from Djebel Fekirine, Central Tunisia.

MATERIAL: FSIT MSN19, from NE of Marsa (Padern area).

DESCRIPTION: The specimen has a maximum preserved diameter of 40.7 mm. Coiling appears to have been moderately involute, the whorl section depressed, with flattened flanks, broadly rounded ventrolateral shoulders and a feebly convex venter in intercostal section; the costal section is polygonal. Primary ribs bear small umbilical bullae, and are straight and prorsirsdiate, strengthening progressively across the flanks, and linking to strong inner ventrolateral bullae. A broad rib links to a slightly weaker outer ventrolateral clavus, from which a low feebly convex rib extends across the venter and bears a subequal siphonal clavus. One or two ribs intercalate between successive primaries; some bear inner ventrolateral and siphonal tubercles; other, shorter intercalatories either lack, or have a very weak inner ventrolateral tubercle. The badly preserved venter reveals two interspaces to be deepened into poorly defined constrictions.

DISCUSSION: Although poorly preserved, the specimen differs in no significant respects from the smaller paratype figured by Pervinquière (1907), as his pl. 12, fig. 2.

OCCURRENCE: Lower Turonian of Central Tunisia and the southern Corbières, Aude France.

Kamerunoceras sp.
(Text-fig. 27O, P)

MATERIAL: FSIT MC2, from the Saint-Louis syncline.

DESCRIPTION: The specimen is 120° whorl sector with a maximum preserved whorl height of 19.5 mm. Coiling appears to have been relatively evolute, the whorl section compressed rectangular-trapezoidal. There are five primary ribs on the fragment. They arise on the umbilical wall, and strengthen into well-developed umbilical bullae. These give rise to straight, prorsirsdiate, widely separated ribs that link to feeble inner ventrolateral bullae and stronger outer ventrolateral clavi. The venter is worn, with a blunt siphonal ridge, possibly strengthened into siphonal clavi, although the preservation is defective.

DISCUSSION: This poor fragment is distinguished by its whorl section and sparse ribbing. It is assigned to *Kamerunoceras* on the basis of similarities to both *Kamerunoceras inaequicostatus* (Wiedmann, 1960) (p. 736, pl. 2, figs 5, 6, text-figs 2, 3; 1964, p. 125, text-figs 5a, b, 6, 7; Kennedy and Wright 1979a, pl. 1, figs 1–3) from northern Spain, and *Kamerunoceras seitzi* (Riedel, 1932) as figured by Kennedy and Wright (1979a, p. 1169, text-fig. 1), from Cameroon.

OCCURRENCE: As for material.

Genus *Romaniceras* Spath, 1923
(=*Tunesites* Pervinquière, 1907; *Proromaniceras* Wiedmann, 1960)

TYPE SPECIES: *Ammonites deverianus* d'Orbigny, 1841, p. 356, pl. 110, figs 1, 2, by the original designation of Spath, 1923, p. 144.

Romaniceras sp. juv.
(Text–figs 20E, G, 22A–C; 28F, G, J, K)

MATERIAL; FSIT MSSP/4 and 5, from the Padern area; FSIT CTP2, from Les Capitaines.

DESCRIPTION: The early, *Tunesites* stage of *Romaniceras* is represented by a series of tiny specimens. FSIT MSSP/5 (Text-fig. 28F, G) is an approximately 60° sector of phragmocone with a maximum preserved whorl height of 4.6 mm. The whorl section is slightly depressed reniform. At the adapical end of the fragment, there is a well-developed constriction, prorsiradiate on the flanks, and broadly convex on the venter. It is flanked by well-developed collar-ribs that bear feeble ventrolateral bullae and a suggestion of a transversely elongated siphonal tubercle. There are traces of feeble ribs on the succeeding sector of the whorl, and a second feebly developed con-

striction towards the adapertural end. The adapical collar rib of this constriction is well-developed on the inner flank, and incipiently bullate, effaced on the mid-flank, and strengthened into a ventrolateral bulla and a feebler siphonal tubercle. The adapertural collar rib is weaker, but also bears ventrolateral and siphonal tubercles. FSIT CTP2 (Text-fig. 28J, K) is a 180° whorl sector of a limonitic phragmocone with a maximum preserved diameter of 7.8 mm. Coiling is moderately involute, the whorl section depressed reniform. Three low, broad, blunt bullae perch on the umbilical shoulder and give rise to a low, broad rib that weakens across the flanks and crosses the venter in a broad convexity, becoming near-obsolete at mid venter. The adapical rib is succeeded by a broad, shallow constriction, most prominent on the venter. FSIT MSSP/4 (Text-fig. 22A–C) is a well-preserved limonitic internal mould of a phragmocone deformed into an ellipse with a maximum preserved diameter of 16 mm. Coiling is moderately involute, the umbilicus quite deep, with a flattened, outward-inclined umbilical wall and a broadly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.79, the flanks feebly convex and convergent, the ventrolateral shoulders broadly rounded, the venter feebly convex. The adapical 240° sector of the outer whorl is smooth. Blunt umbilical bullae of variable strength are present on the adapertural 120° sector, and give rise to one or two low, broad primary ribs. These are prorsiradiate and straight to incipiently flexuous, broadening and strengthening across the flanks. All ribs bear a feeble rounded inner ventrolateral tubercle, from which a broad rib sweeps forwards to a much stronger, feebly clavate outer ventrolateral tubercle. These tubercles are slightly offset across the venter, and give rise to a low, progressively effacing prorsiradiate rib, producing an asymmetric ventral chevron. Both FSIT MSSP/5 and FSIT CTP2 preserves the sutures (Text-fig. 20E, G), which are only very slightly incised; E/A is broad and bifid, A narrow, A/U2 with a slight median incision.

DISCUSSION: That *Tunesites* are the innermost whorls of *Romaniceras* is demonstrated by their association with outer whorls of typical individuals of *R*. (*R*.) *deverianum* as demonstrated by Kennedy *et al*. (1980a, p. 330) and *R*. (*R*.) *mexicanum*, as demonstrated by Kennedy and Cobban (1988a, text-fig. 6A, B). The present specimens correspond well with the types of both *Tunesites salambo* Pervinquière, 1907 (p. 256, pl. 12, figs 5, 6; text-fig. 101) and *T. choffati* Pervinquière, 1907 (p. 257, pl. 12, figs 7, 8; text-fig. 102; the types are refigured by Kennedy *et al*. 1980a, pl. 39, figs 11–23). Furthermore, FSIT MSNP4 corresponds well with the comparable ontogenetic stage of *Eucalycoceras constrictum* Spath, 1926a (= *Acanthoceras* aff. *Newboldi* Kossmat of Pervinquière, 1910, p. 45, pl. 4, fig. 37, holotype refigured by Kennedy *et al*. 1980a, pl. 39, figs 8–10). The age of these North African specimens is given as Cenomanian, by Pervinquière, but a Turonian age is likely (see discussion in Kennedy *et al*. 1980a, p. 331). Specimens of otherwise Turonian taxa from the environs of Berrouaghia (Algeria) collected by Thomas and Peron and assigned a Cenomanian age, include not only *Romaniceras* (*R*.) *deverianum* (= *Eucalycoceras constrictum* Spath, 1926a = *Acanthoceras* aff. *newboldi* Kossmat of Pervinquière 1910, p. 45, pl. 4, fig. 37), but also species of *Coilopoceras*, *Eubostrychoceras* and *Hyphantoceras*.

OCCURRENCE: As for material.

Subgenus *Romaniceras* (*Romaniceras*) Spath, 1923

Romaniceras (*Romaniceras*) *mexicanum* Jones, 1938
(Text-figs 15K, O; 16G; 18; 19A)

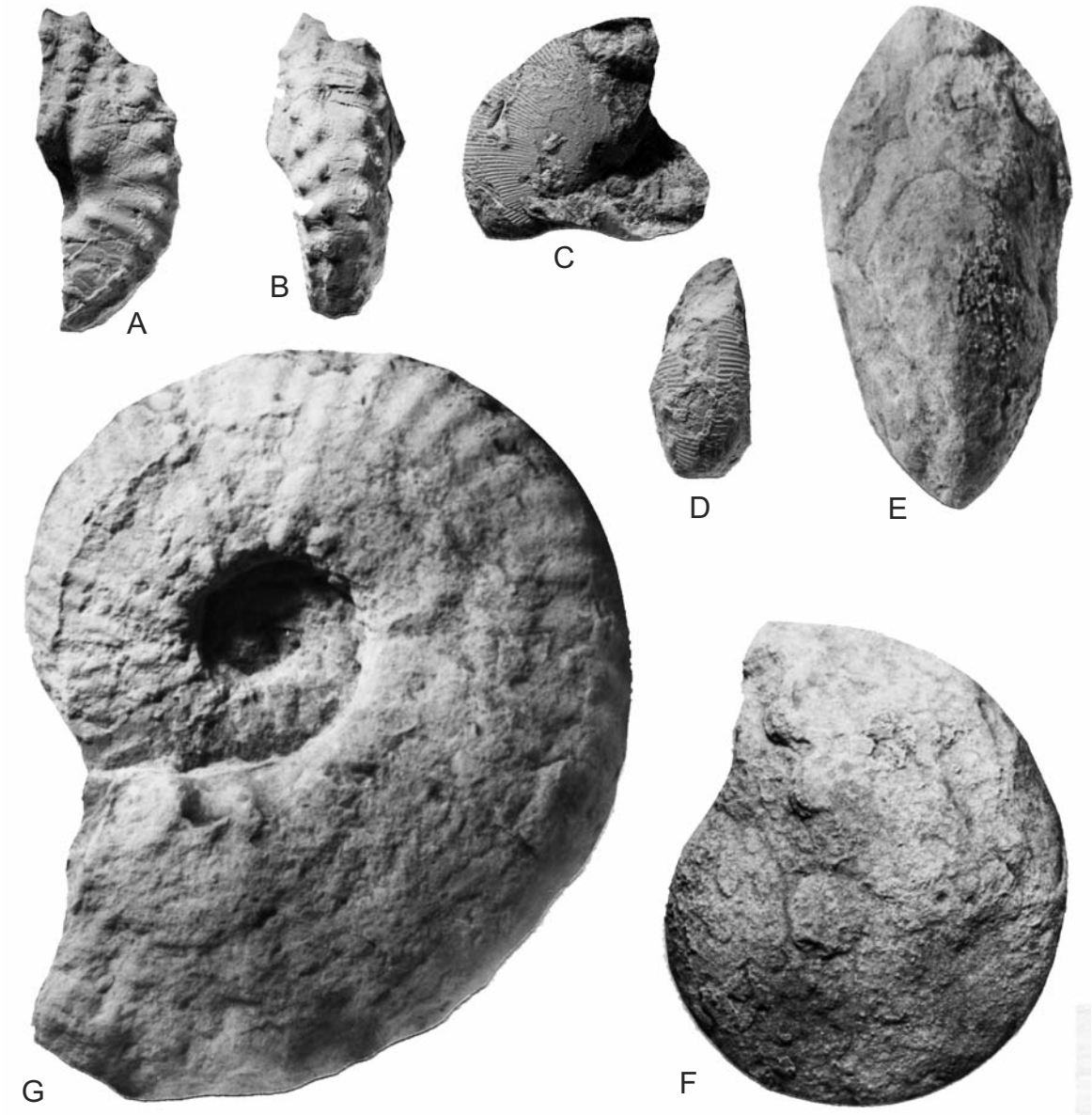
1938. *Romaniceras* (*Romaniceras*) *mexicanum* Jones, p. 121, pl. 7, figs 1, 6.
1981. *Romaniceras deveriai* Orbigny; Bilotte and Calandra, p. 47, pl. 2, fig. 3, *non* pl. 1, fig. 3 (= *R*. (*Y*.)) cf. *ornatissimum* (Stoliczka, 1864).
1988a. *Romaniceras* (*Romaniceras*) *mexicanum* Jones; Kennedy and Cobban, p. 25, figs 2, 3, 5, 6a–d, g; 7–10 (with synonymy).
1988b. *Romaniceras* (*Romaniceras*) *mexicanum* Jones; Kennedy and Cobban, p. 601, text-figs 5:9, 10; 16, 17.
2014. *Romaniceras* (*Romaniceras*) *mexicanum* (Jones, 1938); Amédro and Devalque *in* Robaszynski *et al*., p. 139, pl. 21, figs 1, 2; pl. 22, figs 1, 2; pl. 23, fig. 1; pl. 24, fig. 1.

TYPE: The holotype is no. 16928 in the collections of the University of Michigan, the original of Jones, 1938, p. 121, pl. 7, figs 1, 6; there are four paratypes. The type material is from the Turonian Indidura Formation north of Tanque Toribio in the Sierra de Santa Anna, Coahuila Province, Mexico.

MATERIAL: FSIT MS1, MS3, MSN1, from the Padern area; FSIT MC 9, FSIT CT6, FSIT MSSP5, from the Saint-Louis syncline

DESCRIPTION: The present specimens are large individuals, up to 200 mm in diameter. There are both gracile (Text-figs 15K, O, 16G, 19A) and robust variants (Text-fig. 18C, D). FSIT MC9 is the most complete, but

worn gracile individual, a phragmocone 112 mm in diameter with flattened subparallel flanks, broadly rounded ventrolateral shoulders and a flattened venter. There are over 40 ribs per whorl, primaries with small umbilical bullae, weak lateral bullae and well-developed inner ventrolateral bullae, outer ventrolateral and siphonal clavi. Ornament is better preserved in more fragmentary specimens with crowded ribbing such as FSIT MS1 (Text-fig. 15K, O), with a maximum preserved diameter of 93 mm, with small sharp umbilical bullae and tiny lateral bullae on the primary ribs, stronger feebly bullate inner ventrolateral tubercles, and feeble outer ventrolateral and siphonal clavi. FSIT CT6 (Text-fig. 18C, D) is a robustly ornamented individual 114 mm in diameter, in part body chamber. Coiling is moderatly involute, the umbilicus comprising 26% of the diameter, and of moderate depth, with a flattened wall and narrowly rounded umbilical shoulder. The whorl section is rectangular, with flattened subparallel flanks, broadly rounded ventrolateral shoulders and a very feebly convex, flattened venter in costal section. There are an estimated nine primary ribs on the adapertural half of the outer whorl. They arise at the umbilical seam, sweep back across the umbilical wall, and



Text-fig. 16. A, B – *Mammites powelli* Kennedy, Wright and Hancock, 1987, FSIT MSNP3, from Marsa (Padern area). C, D – *Phylloceras* (*Hypophylloceras*) cf. *masiaposensis* Collignon, 1956, FSIT DS8, from N of Devès. E, F – *Choffaticeras* (*Leoniceras*) sp., FSIT MB600, from Baillesats. G – *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938, FSIT MC9, from the Marnes supérieures de Saint-Louis. Figures A, B, are × 2; figs C-G are × 1

strengthen into blunt umbilical bullae. These give rise to single straight prorsiradiate primary ribs, with a second rib in some cases loosely attached to a bulla. Intercalated ribs arise both high and low on the flanks, and alternate regularly with the primaries. Some primaries and long intercalatories bear the slightest indication of a lateral bulla, and all ribs bear inner ventrolateral bullae and outer ventrolateral and siphonal clavi.

DISCUSSION: *Romaniceras* (*R*.) *deverianum* (d'Orbigny, 1841) (p. 356, pl. 110, figs 1, 2, see revision in Kennedy *et al*. 1980a, p. 332, pl. 39, figs 7–10; pl. 41, figs 1–6; pl. 42, figs 1–7, pl. 43, figs 1–3 text-figs 1, 3d, 4, 5 (with full synonymy), and Amédro and Devalque *in* Robaszynski *et al*. 2014, p. 140, pl. 13, fig. 1; pl. 37, fig. 3; pl. 38, figs 1, 2) can be distinguished from the present species by umbilical bullae that project into the umbilicus in middle growth, while the adults are slender with relatively weak ribbing, and as noted by Cobban and Kennedy (1988a, p. 33), do not develop the massive trapezoidal whorls with coarse, distant ribbing of adult *mexicanum.*

Romaniceras (*Romaniceras*) *kallesi* Zázvorka, 1958 (p. 39, pl. 1, figs 1, 2), from the Turonian of the Weisserberg, near Prague in the Czech Republic, is comprehensively revised by Kennedy *et al.* (1980a, p. 342, pl. 44, figs 1–3 pl. 45, figs 2–7; pl. 46, figs 1–4; pl. 47, figs 1–4; *non* text-fig. 6; see also Amédro 2009, p. 25, pl. 1, fig. 2). It comes from a lower horizon than the present species, from which it differs in middle and later growth by the evolute coiling, a lower expansion rate, and delicate narrow ribs that are dominant over the tubercles. On the venter the ribs are narrower and more widely spaced, with a tendency for the flanks and venter to remain flattened, rather than becoming convex, while the outer ventrolateral tubercles are rounded to transversely elongated rather than clavate.

OCCURRENCE: Middle Turonian, occurring in the *Prionocyclus hyatti* Zone in northern Mexico, Texas and New Mexico in the United States; Middle Turonian of Uchaux, Vaucluse, and the southern Corbières in Aude, France (the present records).

Subgenus *Romaniceras* (*Yubariceras*) Matsumoto, Saito and Fukada, 1957

TYPE SPECIES: *Yubariceras yubarense* Matsumoto, Saito and Fukada, 1957, p. 27, pl. 8, fig. 1; pl. 10. fig. 1; pl. 11, fig. 1; pl. 13, fig. 1; pl. 15, fig. 1; text-figs 8, 9, by original designation=*Ammonites ornatissimus* Stoliczka, 1864, p. 75, pl. 40.

Romaniceras (*Yubariceras*) *ornatissimum* (Stoliczka, 1864) (Text-figs 15C–F, I, J, L; 18A, B)

1864. *Ammonites ornatissimus* Stoliczka, p. 75, pl. 40, figs 1a–e.

1980a. *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka); Kennedy *et al*., p. 348, pl. 39, figs 1–6; pl. 40, figs 1, 3–5; pl,. 45, fig. 1; pl. 48, figs 1–4; pl. 49, figs 1–8; pl. 50, figs 1–4; text-figs 3e, 7, 8 (with synonymy).

2011. *Romaniceras ornatissimum*; Bilotte, p. 71, text-fig. 3.

2011. *Romaniceras* cf. *ornatissimum*; Bilotte, p. 71, text-fig. 2.7–2.9.

2014. *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka, 1864); Amédro and Devalque *in* Robaszynski *et al*., p. 141, pl. 16, fig. 1; pl. 17, fig. 1; pl. 18, fig. 1 (with additional synonymy).

TYPE: The holotype, by monotypy, is no. 174 in the collections of the Geological Survey of India, Kolcatta, the original of Stoliczka 1864, p. 75, pl. 40, figs 1a–e, from Utatur Group of Odium, Tamil Nadu, South India.

MATERIAL: FSIT 3b/1–4, FSIT MT1, from the Calcaires de Montplaisir; FSIT MC15, from the Saint-Louis syncline.

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
FSIT MC15	112.0(100)	56.8(50.7)	51.6(46.1)	1.1	23.2(20.7)

DESCRIPTION: FSIT 3b/1–4 (Text-fig. 15C–F, I, J, L) are juveniles between 26 and 30 mm in diameter. Coiling is evolute, the whorl section as wide as high to slightly depressed, and subcircular to reniform in intercostal section. The umbilicus is of moderate depth, with a convex wall. Ornament is of predominantly primary ribs that arise at the umbilical seam and strengthen into weak to strong umbilical bullae; there are also long intercalated ribs that arise low on the flank. The ribs are straight and prorsiradiate on the flanks, across which they strengthen progressively, and cross the venter in a shallow convexity. There are 11 rows of tubercles on the primary ribs: umbilical bullae, rounded to bullate lateral, rounded inner ventrolateral and outer ventrolateral, ventral and siphonal clavi. There are two to three prominent narrow constrictions per half whorl, at maximum development across the venter; they are flanked by adapical and adapertural collar ribs with a full complement of tubercles. FSIT MT1 (Text-fig. 15G, H) is a somewhat larger nucleus 31.6 mm in diameter with a comparable style of much better preserved ribbing and tuberculation.

FSIT MC15 (Text-fig. 18A, B) is a well-preserved internal mould with a maximum preserved diameter of 112 mm. Coiling is moderately involute, with a deep umbilicus, the umbilical wall flattened, and the umbilical shoulder broadly rounded. The whorl section is depressed subcircular in costal section, with feebly convex flanks, broadly rounded ventrolateral shoulders, and a broad, feebly convex venter. The costal whorl section is polygonal, with a whorl breadth to height ratio of 1.1, the greatest breadth at the lateral tubercles. Fifteen to sixteen primary ribs arise at the umbilical seam, strengthen across the umbilical wall and shoulder, and are straight and prorsiradiate across the flanks. They bear a well-developed umbilical bulla, a strong, sharp lateral bulla, and a strong, rounded inner ventrolateral tubercle. A broad, strong, straight rib extends across the venter, and bears strong outer ventrolateral, ventral and siphonal clavi. Long intercalated ribs lack an umbilical bulla, while shorter intercalated ribs may also lack a lateral bulla. One or two of these intercalated ribs separate successive primaries on the adapical part of the outer whorl. On the adapertural part, all of the ribs are primaries, to give a total of 26 ribs at the ventrolateral shoulder of the outer whorl.

DISCUSSION: The presence of 11 rows of tubercles, diagnostic of *Romaniceras* (*Yubariceras*), separates these specimens from species of *Romaniceras* (*Romaniceras*) in the present faunas. The species is comprehensively revised by Kennedy *et al.* (1980a).

OCCURRENCE: Middle Turonian, Sarthe, Touraine, Vaucluse, Aube, and the southern Corbières, Aude, in France, northern Spain, the Czech Republic, Tunisia, Israel, Lebanon, Madagascar, South India, Japan, California and Texas in the United States, and northern Mexico.

Subfamily Mammitinae Hyatt, 1900
(=Buchiceratinae Hyatt, 1903; Metoicoceratinae Hyatt, 1903; Fallotitinae Wiedmann, 1960)

Genus *Mammites* Laube and Bruder, 1887
(=*Schluetericeras* Hyatt, 1903, p. 110)

TYPE SPECIES: *Ammonites nodosoides* Schlüter, 1871, p. 19, pl. 8, figs 1–4, by monotypy (*fide* Wright and Kennedy 1981, p. 75).

Mammites nodosoides (Schlüter, 1871)
(Text-fig. 19D)

1871. *Ammonites nodosoides* Schlüter, p. 19, pl. 8, figs 1–4.
1967. *Mammites chouberti* Collignon, p. 41, pl. 22, fig. 1.
1981. *Mammites nodosoides* (Schlüter, 1871); Wright and Kennedy, p. 75, 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; text-figs 19b, 23, 24 (with synonymy).
?1982. *Mammites nodosoides* (Schlotheim); Tzankov, p. 46 (*pars*), ?pl. 22, fig. 2; *non* pl. 22, fig. 3 (= *Spathites* (*Jeanrogericeras*) sp.?).
1982. *Mammites nodosoides afra* Pervinquière; Tzankov, p. 46, pl. 22, figs 4, 5.
1994. *Mammites nodosoides* (Schlüter, 1871); Kennedy, p. 260, pl. 1, figs 7–11; pl. 2, figs 3–5.
1997. *Mammites nodosoides* (Schlüter, 1871); Wiese, pl. 1, figs 1, 7.
2001. *Mammites nodosoides* (Schlotheim); Aly and Abdel-Gawad, p. 34, pl. 4, fig. 1.
2002. *Mammites nodosoides* (Schlüter); El Hendy, p. 402, text-fig. 3c.
2003. *Mammites nodosoides* (Schlüter); Wittler and Roth, p. 273, text-fig.17.
2007. *Mammites nodosoides* (Schlüter, 1871); Barroso-Barcenilla, p. 148, pl. 11, figs a–d (with additional synonymy).
2007. *Mammites nodosoides* (Schlüter, 1871); Ifrim and Stinnesbeck, p. 651, text-figs 5e, 11.
2008. *Mammites nodosoides* (Schlüter, 1871); Kennedy *et al*., p. 154, pl. 1, figs 1–5; pl. 2, fig. 8; text-fig. 4.
2008. *Mammites nodosoides* (Schlüter, 1871); Lehmann and Herbig, p. 71, pl. 1, figs j–k, r–s.
2008. *Mammites nodosoides* (Schlüter, 1871); Ifrim and Stinnesbeck, text-fig. 10f.
2011. *Mammites nodosoides* (Schlüter, 1871); Kennedy *et al*., p. 227, text-fig. 16m–p.
2013. *Mammites nodosoides* (Schlüter, 1871); Wilmsen and Nagm, p. 666, text-figs 17g–h; 18a–b.
2014. *Mammites nodosoides* (Schlüter, 1871); Amédro and Devalque *in* Robaszynski *et al*., p. 144, pl. 3, figs 1, 2.
2014. *Mammites nodosoides* (Schlüter, 1871); Wilmsen and Nagm, p. 218, text-fig. 10a, b.

TYPE: the lectotype, by the subsequent designation of Wright and Kennedy 1981, p. 76, is the original of Schlüter 1871, p. 21, footnote 1, no. C555 in the collections of the Museum für Naturkunde of the Humboldt University, Berlin, and from the Turonian of Měcholupy [Michelob] in The Czech Republic. It was refigured by Wright and Kennedy (1981, text-fig. 23).

MATERIAL: FSIT MSN5, 6, 13, from the Padern area.

DESCRIPTION: Three specimens are referred to the species with confidence. FSIT MSN5 (Text-fig. 19D) is

a juvenile 125 mm in diameter, a relatively compressed individual. Widely separated umbilical bullae, four per half whorl, give rise to one, occasionally two primary ribs, with shorter ribs intercalating. At the beginning of the outer whorl, conical inner and clavate outer ventrolateral tubercles are clearly differentiated. As size increases, they merge into a single laterally compressed ventrolateral horn. FSIT MSN13 is a larger fragment, and shows the inner and outer ventrolateral tubercles differentiated to a whorl height of 60 mm. FSIT MSN6 is 165 mm in diameter. The whorl section is massive, and trapezoidal. There are six massive umbilical bullae on the outer half whorl. These give rise to broad, straight, low, recti- to feebly prorsiradiate ribs that efface across the flank region before strengthening into a conical inner ventrolateral tubercle, linked by a low, broad rib to a coarse outer ventrolateral tubercle.

DISCUSSION: The specimens are very typical representatives of this extensively documented species; see accounts in Wright and Kennedy (1981), and illustrations of well-preserved Moroccan specimens in Kennedy *et al*. (2008).

OCCURRENCE: Lower Turonian, *Mammites nodosoides* Zone and correlatives, Germany, southern Belgium, France, England, Spain, the Czech Republic, Romania, Bulgaria, Turkmenistan, Lebanon, Israel, Egypt, Tunisia, Algeria, Morocco, Nigeria, Madagascar, Peru, Brazil, Colombia, northern Mexico, and the United States Western Interior.

Mammites powelli Kennedy, Wright and Hancock, 1987
(Text-figs 16A, B; 28L, M)

1987 *Mammites powelli* Kennedy *et al*., p. 42, pl. 3, figs 1–14; pl. 4, figs 16, 17; text-fig. 2f, g (with synonymy).

TYPE: The holotype is OUM KT404, from the Lower Turonian *Pseudaspidoceras flexuosum* Zone fauna of Bed B of the Ojinaga Formation of Calvert Canyon, Hudspeth County, Texas (Kennedy *et al*. 1987, pl. 3, figs 13, 14). There are 19 paratypes from the same horizon and locality.

MATERIAL: FSIT MSNP3 from Marsa (Padern area); FSIT BS1, from Baillesats.

DESCRIPTION: MSNP3 (Text-fig. 16A, B) is a well-preserved internal mould of a 180° whorl sector with a maximum preserved diameter of 25.9 mm. Coiling is involute, the umbilicus comprising 15% of the diameter, deep, with a flattened, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is trapezoidal in intercostal section, with the greatest breadth at the umbilical shoulder, the flanks flattened and convergent, the ventrolateral shoulders broadly rounded, the venter flattened. The greatest breadth is at the umbilical bullae in costal section. There are four bullae, weak at the adapical end, but massive and conical at the adapertural end of the fragment. They give rise to coarse, straight, recti- to feebly prorsiradiate ribs, whilst additional ribs intercalate on the flanks to give a total of 12 ribs at the ventrolateral shoulder. All ribs bear a small conical inner ventrolateral tubercle, linked by a broad rib to a much stronger outer ventrolateral clavus on either side of the broad venter, across which they are linked by a broad, flattened rib. The sutures have a broad, bifid E/A and a narrow A.

FSIT BS1 (Text-fig. 28L, M) is a much larger fragment of an individual with an estimated maximum diameter of 44.5 mm. It has the same distinctive trapezoidal whorl section as the previous specimen, with coarse straight ribs arising in pairs from massive bullae and bearing small inner ventrolateral tubercles and outer ventrolateral clavi.

DISCUSSION: FSIT MSNP3 differs in no significant respects from small topotypes of *Mammites powelli* (Kennedy *et al*., 1987, pl. 3, figs 3–5), and FSIT BS1 agrees well with the original of pl. 3, figs 1, 2, in the same work. When compared to small nuclei of *Mammites nodosoides* (for example Renz 1982, pl. 27, figs 3, 5, 6–10), the trapezoidal rather than rectangular whorls of the present species, together with the massive umbilical bullae, are distinctive.

OCCURRENCE: Lower Turonian *Pseudaspidoceras flexuosum* Zone of Trans-Pecos Texas, together with the present records from the southern Corbières, Aude, France.

Genus *Spathites* Kummel and Decker, 1954

TYPE SPECIES: *Spathites chispaensis* Kummel and Decker, 1954, p. 311, pl. 30, figs1, 2; pl. 31, figs 2–8, by original designation.

Subgenus *Jeanrogericeras* Wiedmann, 1960
(=*Fallotites* Wiedmann, 1960, p. 741)

TYPE SPECIES: *Ammonites revelieranus* Courtiller,

1860, p. 249, pl. 2, figs 5–8, by original designation by Wiedmann, 1960, p. 741).

Spathites (*Jeanrogericeras*) *revelieranus* (Courtiller, 1860)
(Text-fig. 21A–C)

1860. *Ammonites revelieranus* Courtiller, p. 249, pl. 2, figs 5–8.
1980b. *Spathites* (*Jeanrogericeras*) *reveliereanus* (Courtiller); Kennedy *et al*., p. 826, pl. 105, figs 1–12; pl. 106, figs 1, 2; text-figs 3–6 (with synonymy).
1981. *Jeanrogericeras binicostatum* (Petrascheck); Bilotte and Calandra, p. 47, pl. 2, fig. 1.
2007. *Spathites* (*Jeanrogericeras*) *reveliereanus* (Courtiller, 1860); Barroso-Barcenilla, p. 138, pl. 4, fig. g; pl. 5, figs a–d; text-figs 6a, b (with additional synonymy).
2013. *Spathites* (*Jeanrogericeras*) *revelieranus* (Courtiller, 1860); Wilmsen and Nagm, p. 664, text-figs 15, 16, 17a–f (with additional synonymy).
2014. *Spathites* (*Jeanrogericeras*) *revelieranus* (Courtiller, 1860); Amédro and Devalque, *in* Robaszynski *et al*., p. 143, pl. 13, fig. 2.
2014. *Spathites* (*Jeanrogericeras*) *revelieranus* (Courtiller, 1860); Wilmsen and Nagm, p. 216, text-fig. 9a.

TYPE: The lectotype, by the subsequent designation of Kennedy *et al*. 1980b (p. 821) is the original of Courtiller 1860, pl. 2, figs 5, 6, refigured by Kennedy *et al*. 1980b, text-fig. 5, from the Tuffeau de Touraine of the environs of Saumur, Touraine, conserved in the collections of the Chateau de Saumur.

MATERIAL: FSIT A2, from the Saint-Louis syncline (Trou des Sorcières), the original of *Jeanrogericeras binicostatum* (Petrascheck) of Bilotte and Calandra, 1981 (p. 47, pl. 2, fig. 1).

DESCRIPTION: The specimen is a worn internal mould 74.5 mm in maximum preserve diameter, in part body chamber, although the position of the final septum cannot be established. Coiling is quite involute, the umbilicus comprising 22% approximately of the diameter, with an estimated 70% of the previous whorl covered. The umbilicus is quite shallow, with a flattened, outward-inclined wall and quite narrowly rounded umbilical shoulder. The inner flanks are feebly convex, the outer flanks flattened and convergent in intercostal section, the greatest breadth close to the umbilical shoulder. The ventrolateral shoulders are broadly rounded, the venter flattened. The costal whorl breadth to heigh tratio is 0.79, with the greatest breadth at the umbilical bullae. Six primary ribs per half whorl arise at the umbilical seam, strengthen across the umbilical wall, and link to conical umbilical bullae. These give rise to pairs of low, broad, straight, coarse prorsirdiate ribs that link to well-developed inner ventrolateral clavi, linked by a broad prorsiradiate rib to stronger outer ventrolateral clavi. These are linked across the venter by a low, broad, transverse rib.

DISCUSSION: This worn compressed *Spathites* (*Jeanrogericeras*) falls within the range of variation of *revelieranus* demonstrated by Wilmsen and Nagm (2013) on the basis of a suite of specimens from Saxony. It is particularly close to the paralectotype of *Mammites binicostatus* Petrascheck, 1902 (a synonym), the original of Petrascheck, 1902, pl. 8, fig. 3, refigured by Wilmsen and Nagm as their text-fig. 17a–c.

OCCURRENCE: Upper Lower and lower Middle Turonian. The geographic distribution extends from Saxony, Germany to Sarthe, Touraine, Aquitaine, Vaucluse, Gard, Provence and the southern Corbières in, Aude in France, The Czech Republic, Romania, northern Spain, and, possibly, Tunisia.

Spathites (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856)
(Text-figs 17A–D; 21D, E)

1856. 17. *A. combesi* d'Orbigny, p. 109.
1951. *Ammonites combesi* d'Orb. in litt.; Sornay, p. 627, text-fig. 1a–d.
1955. *Ammonites* (*Mammites*) *combesi* d'Orbigny; Sornay, fiche 9, text-figs 1, 2.
2007. *Spathites* (*Jeanrogericeras*) *combesi* (Sornay, 1951); Barroso-Barcenilla, p. 140, pl. 5, figs e–f; pl. 6, figs a, b (with synonymy).
2014. *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856); Amédro and Devalque *in* Robaszynski *et al*., p. 143, pl. 2, fig. 3.

TYPE: The lectotype, designated by Sornay, 1955, fiche 9, is the original of Sornay 1951, figs 1a–d, MNHP F–A2310, d'Orbigny Collection 6125, from the Turonian of Fumel, Lot-et-Garonne, France.

MATERIAL: FSIT FR6, 11, FSIT MB700 from La Ferriere (Padern area); FSIT MB699, from Baillesats.

DESCRIPTION: FSIT FR11 (Text-fig. 21D, E) is a well-preserved internal mould of a phragmocone 82.5 mm in diameter. Coiling is moderately evolute, the um-

bilicus comprising 33% of the diameter, deep, with a flattened, outward-inclined wall and broadly rounded umbilical shoulder. The intercostal whorl section is very depressed reniform, with the greatest breadth close to the umbilical shoulder and a whorl breadth to height ratio of 1.39. The greatest breadth is at the umbilical bullae in costal section, with a whorl breadth to height ratio of 1.75. Nine primary ribs arise at the umbilical seam and strengthen across the umbilical wall, developing into massive conical umbilical bullae. These give rise to pairs of low, broad, coarse prorsirdiate ribs with occasional intercalated ribs that strengthen across the flanks and link to coarse blunt transverse ventrolateral bullae, linked across the venter by a low, broad rib, concave in costal profile between the bullae.There is a suggestion of a very feeble inner ventrolateral tubercle at the beginning of the outer whorl. FSIT MB 699 (Text-fig. 17C, D) is an internal mould with a maximum preserved diameter of 120 mm, the adapertural 90° sector body chamber. Coiling is moderately involute, the umbilicus deep, with a flattened outward-inclined wall and broadly rounded umbilical shoulder. The umbilicus comprises an estimated 26% of the diameter. The intercostal whorl section is depressed reniform, with a whorl breadth to height ratio of 1.33, the greatest breadth below midflank, the flanks markedly convex, the ventrolateral shoulders broadly rounded, the venter very broad and feebly convex. The greatest breadth is at the umbilical bullae in costal section, with a whorl breadth to height ratio of 1.55. Six primary ribs arise on the umbilical wall of the fragment, and strengthen into umbilical bullae that are massive on the adapical 120° sector of the fragment. They give rise to pairs of very coarse, broad, straight, feebly prorsiradiate ribs that link to strong ventrolateral bullae, linked over the venter by a low, broad rib. The adapertural three ribs arise from progressively weakening umbilical bullae, the ventrolateral tubercles also declining.

FSIT MB 700 (Text-fig. 17A, B) is a corroded fragment of phragmocone 88 mm in diameter, with comparable ornament, that on the venter better-preserved than in the previous specimens.

FSIT FR6 is a large corroded individual with a maximum preserved diameter of 130 mm.

DISCUSSION: Globose, coarsely ornamented whorls separate these specimens from *S*. (*J*.) *revelieranus*, but it must be admitted that the morphological difference between them is no greater than the range of intraspecific variation see in, for example *Neogastroplites* (Reeside and Cobban, 1960) or *Schloenbachia* (Kennedy, 2013). For comparison with other species, see Kennedy (1994) and Barroso-Barcenilla (2007).

Sornay (1951, 1955) regarded *combesi* as one of d'Orbigny's unpublished species. As noted in the synonymy given by Amédro and Devalque (*in* Robaszynski *et al*. 2014), the species was validly introduced by d'Orbigny in1856.

OCCURRENCE: Upper Lower Turonian, Lot-et-Garonne, Gard, Vaucluse, Bouches-du-Rhone, and the southern Corbières in Aude, France, northern Spain, and Tunisia.

Family Family Vascoceratidae H. Douvillé, 1912
(=Neoptychitinae Collignon, 1965)
Genus *Vascoceras* Choffat, 1898
(see Wright 1996, p. 175, for synonyms)

TYPE SPECIES: *Vascoceras gamai* Choffat, 1898, p. 54, pl. 7, figs 1–4; pl. 8, fig. 1; pl. 10, fig. 2; pl. 21, figs 1–5, by the subsequent designation of Diener 1925, p. 182.

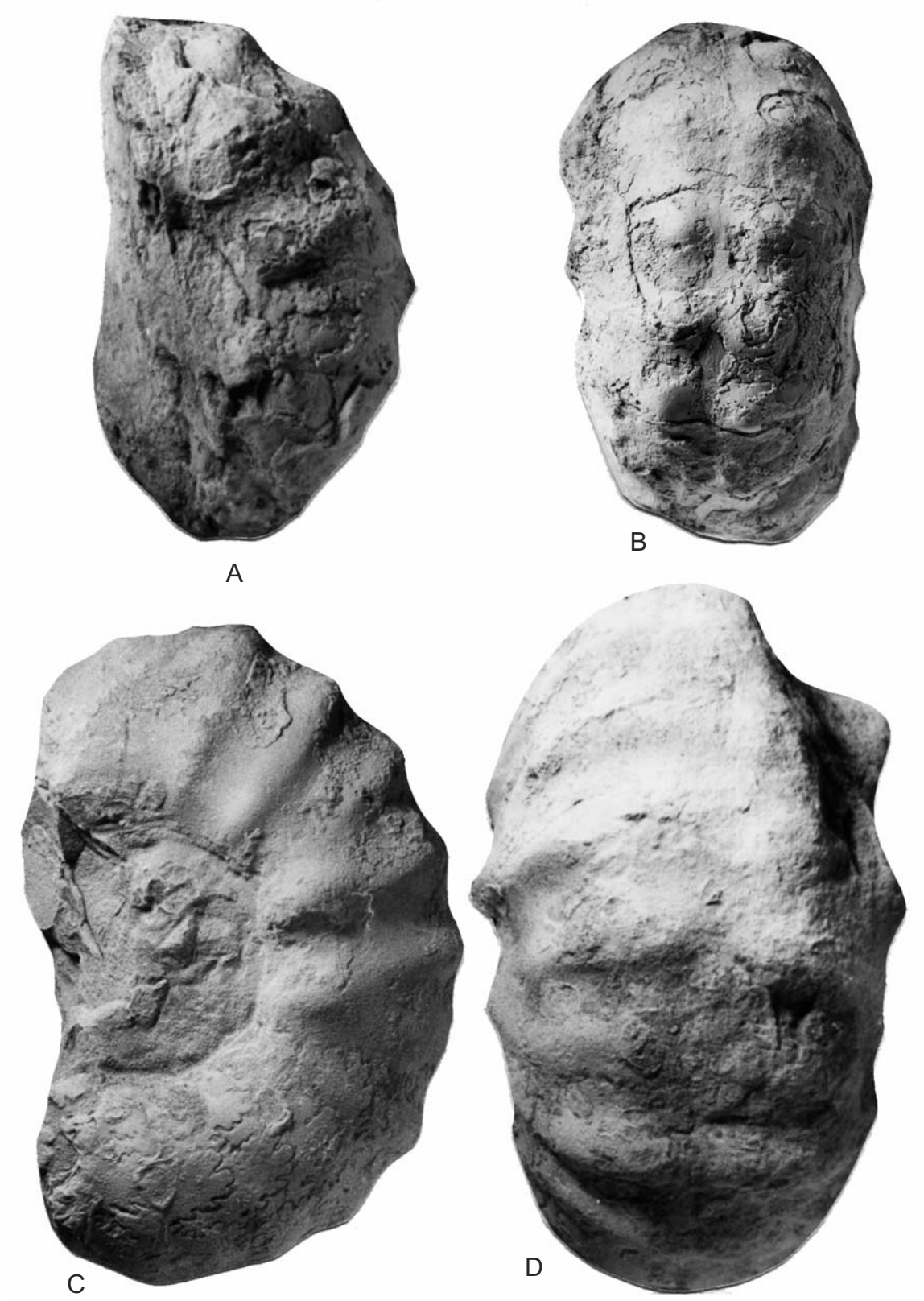
Vascoceras sp. juv.
(Text-figs 20F, 23D–F)

MATERIAL: FSIT MSSP 5 and 6, from Marsa (Padern area).

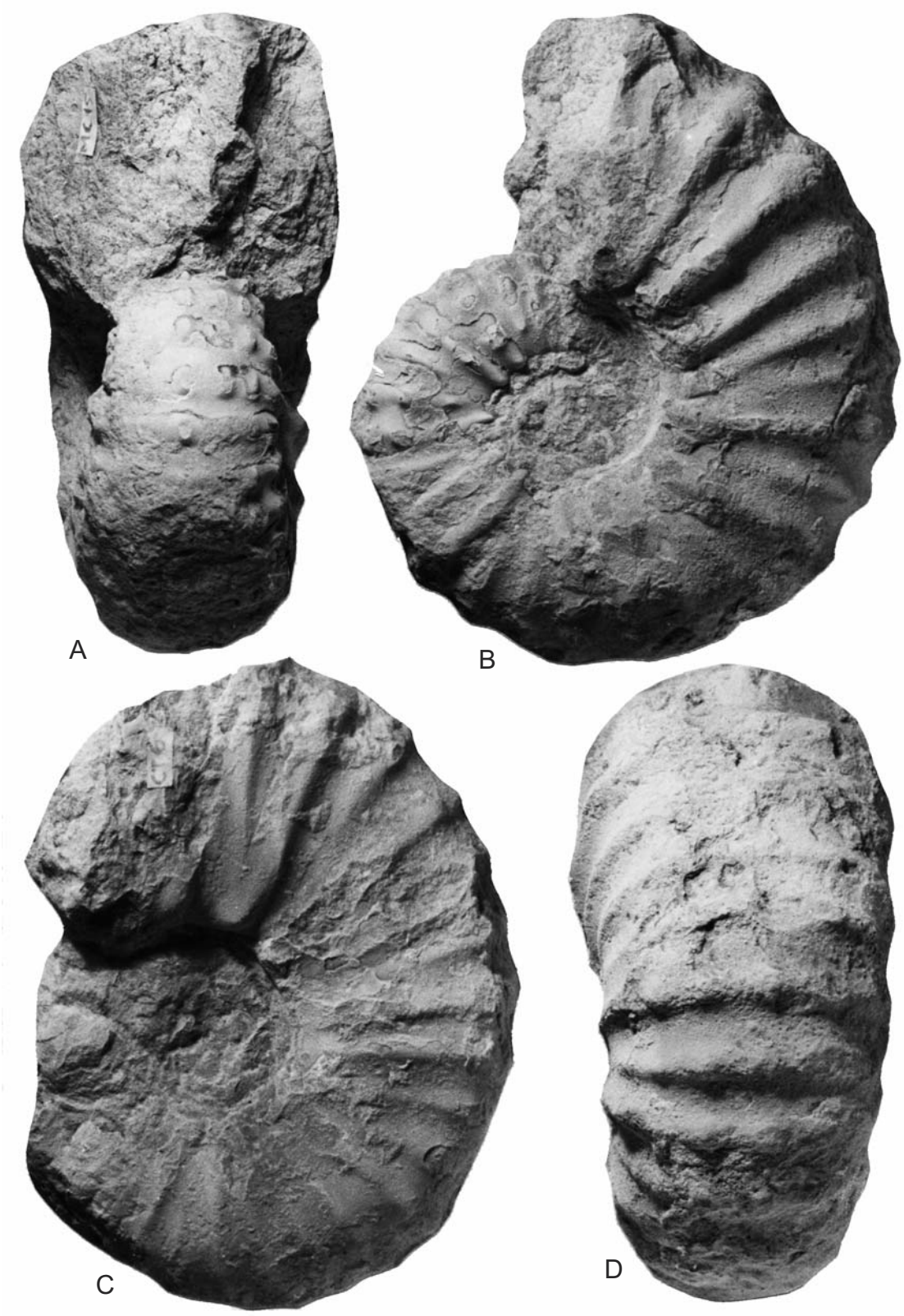
DESCRIPTION: MSSP6 (Text-figs 20F, 23D–F) is a limonitic phragmocone with a máximum preserved diameter of 8.6 mm. Coiling appears to have been involute, with a deep umbilicus and broadly rounded umbilical shoulder. The whorl section is depressed reniform, the flanks convex, the ventrolateral shoulders and venter broadly rounded. An estimated 14 blunt bullae perch on the umbilical shoulder of the outer whorl, and give rise to low broad ribs that efface on the flanks. Five constrictions are visible on the outer whorl. They are deeply incised into the umbilical shoulder and flanks where they are prorsiradiate, weaken on the ventrolateral shoulders and venter, which they cross in a broad convexity. The suture (Text-fig. 20F) is little incised, with a broad triangular E/A, A and A/U2.

FSIT MSSP5 is 4.4mm in diameter and bears three constrictions but no other ornament. The suture is as in the previous specimen.

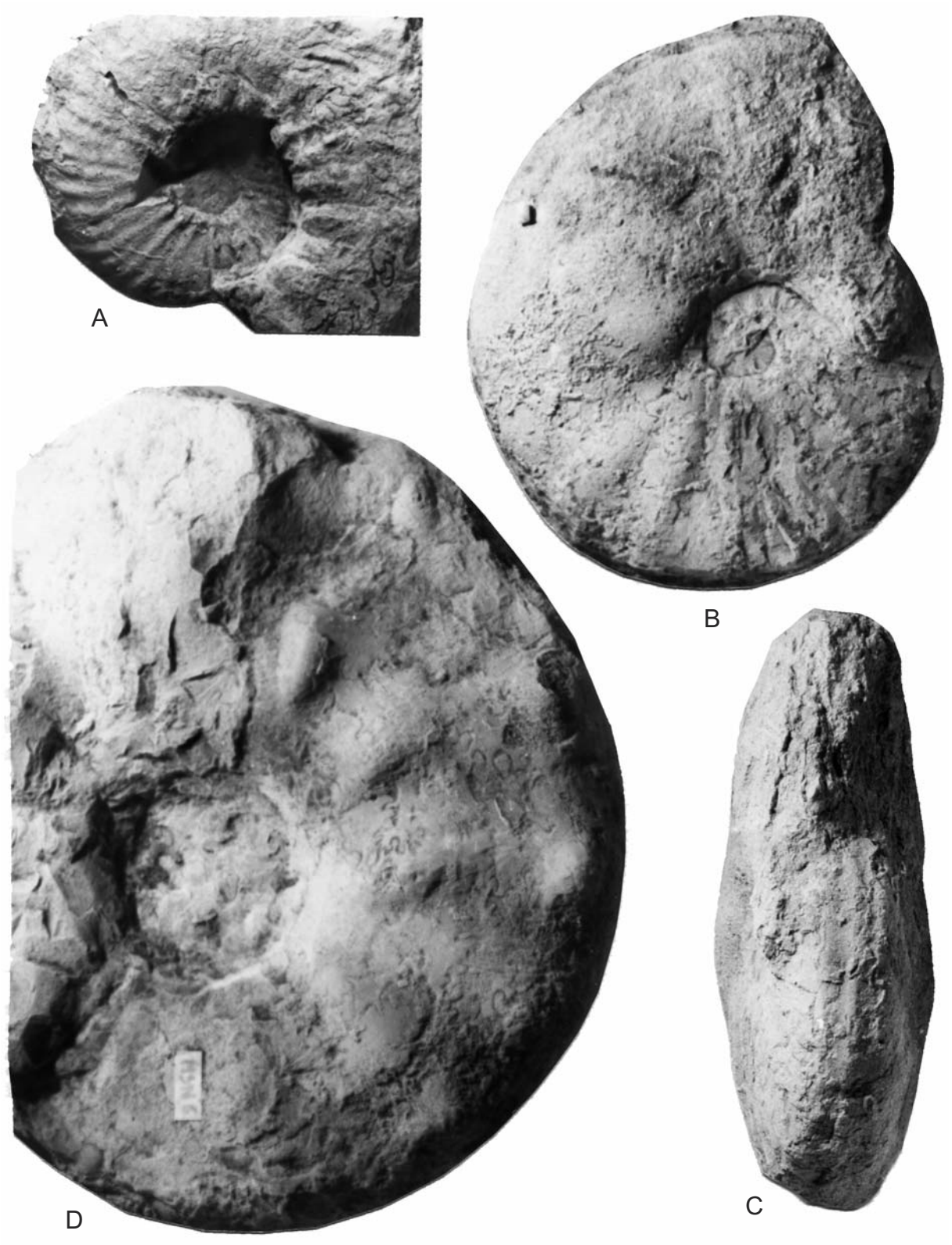
REMARKS: Tiny as these specimens are, their generic assignation is clear on the basis of a comparison with the smallest members of the ontogenetic series of *Vascoceras birchbyi* Cobban and Scott, 1973 figured by Cobban *et al*. 1989, fig. 89a–l. They are, however, specifically indeterminate.



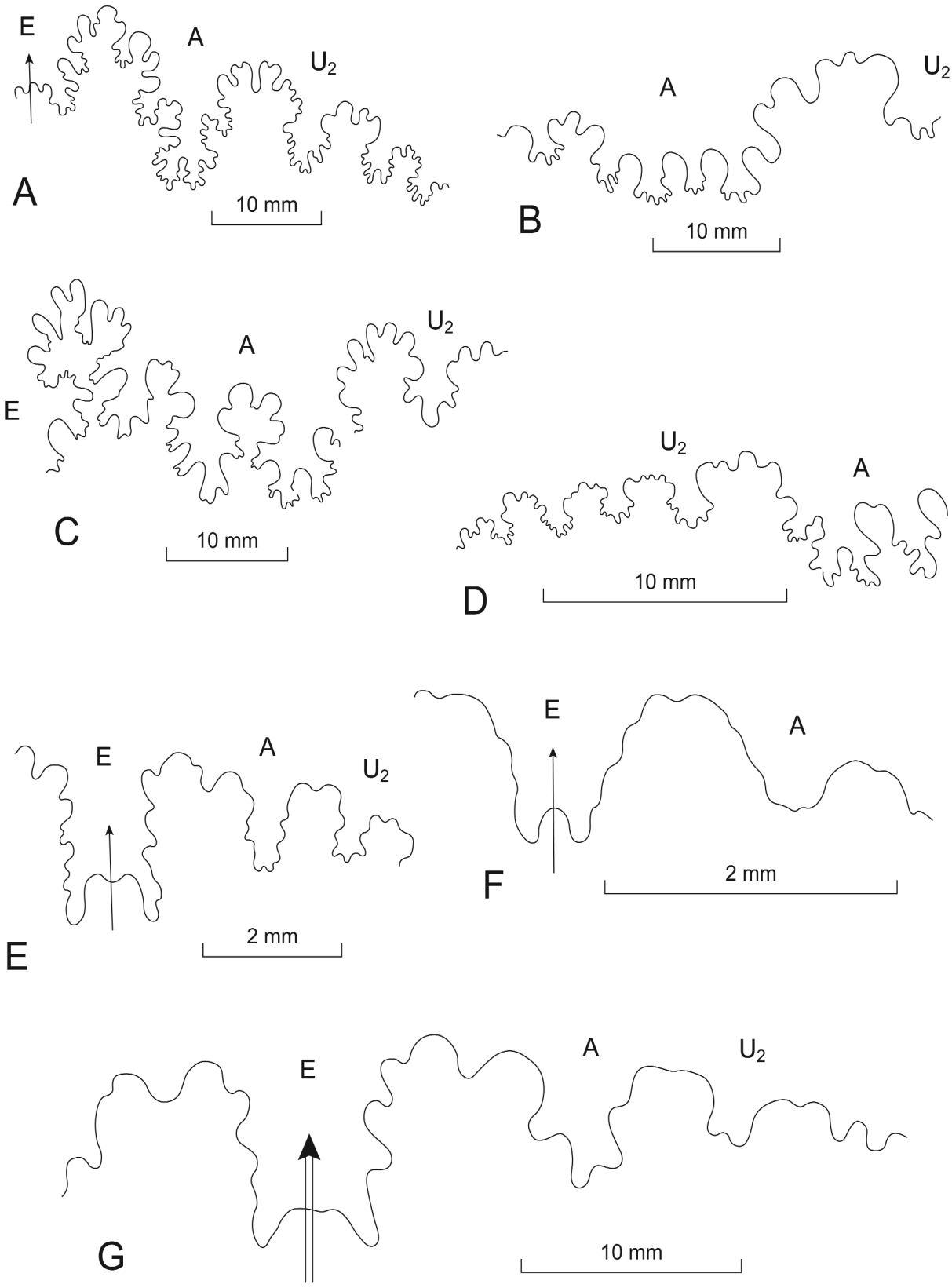
Text-fig. 17. A-D – *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856). A, B, FSIT MB700, from La Ferrière (Padern area). C, D, FSIT MB699, from Baillesats. All figures are × 1



Text-fig. 18. A, B – *Romaniceras* (*Yubariceras*) *ornatissimum* (Stoliczka, 1865), FSIT MC15, from the Calcaires de Montplaisir (Saint-Louis syncline). C, D – *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938, FSIT CT6, from Les Capitaines. All figures are × 1



Text-fig. 19. A – *Romaniceras* (*Romaniceras*) *mexicanum* Jones, 1938, FSIT MS3, from NW of Marsa (Padern area). B, C – *Pseudotissotia galliennei* (d'Orbigny, 1850), FSIT MC5, from the Calcaires de Montplaisir (Saint-Louis syncline). D – *Mammites nodosoides* (Schlüter, 1871), FSIT MSN5a, from NE of Marsa. All figures are × 1



Text-fig. 20. Suture lines. A – *Neoptychites cephalotus* (Courtiller, 1860), UM Sen010a. B – *Wrightoceras wallsi* Reyment, 1954, FSIT FR3. C, D – *Coilopoceras springeri* Hyatt, 1903. C, REII; D, FSIT MS6. E, G – *Romaniceras* sp. juv. E – FSIT CTP2; G – FSIT MNSP5. F – *Vascoceras* sp. juv., FSIT MSSP6.

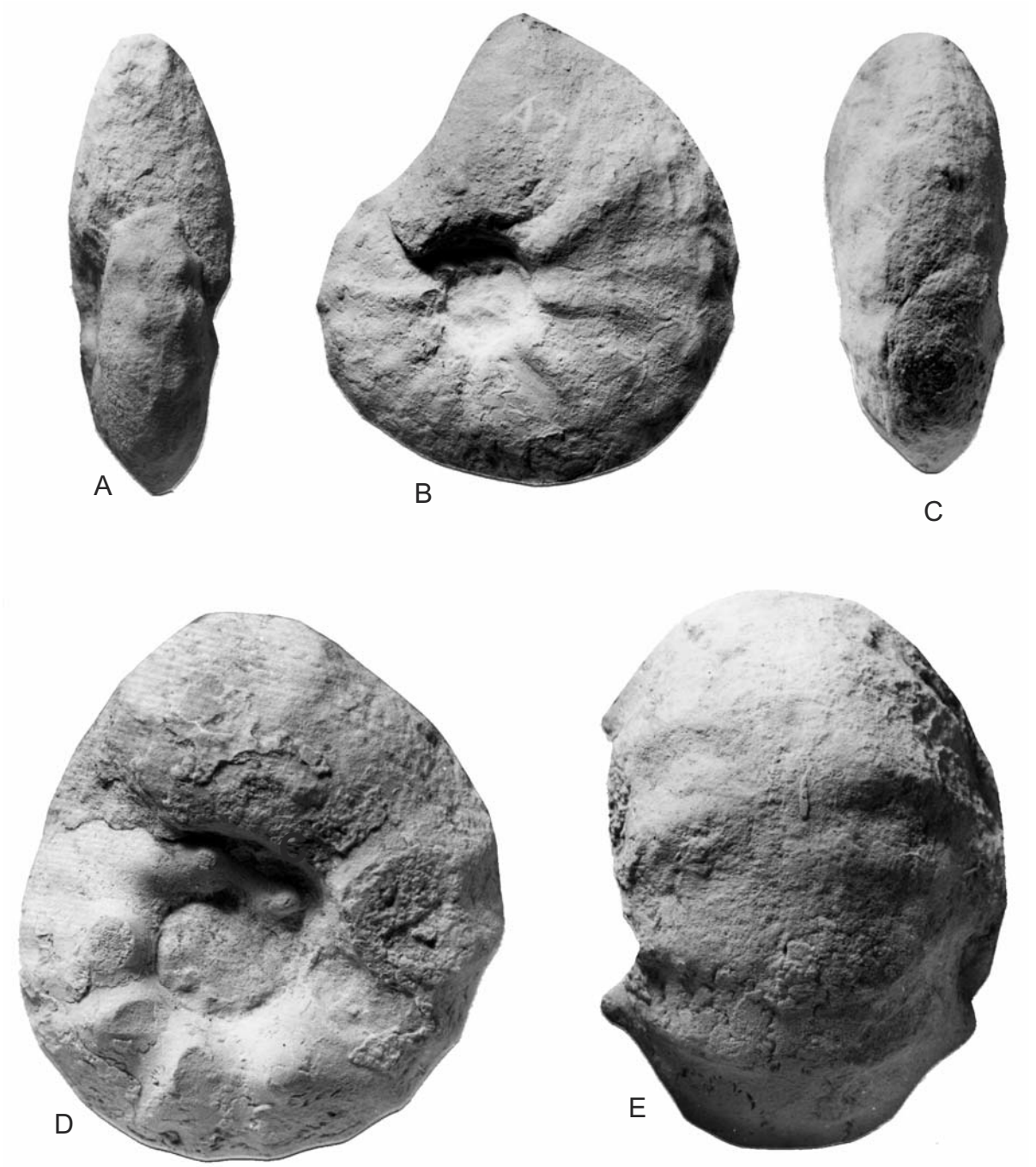
OCCURRENCE: As for material.

Genus *Fagesia* Pervinquière, 1907

TYPE SPECIES: *Olcostephanus superstes* Kossmat, 1897, p. 26 (133), pl. 6 (17), fig. 1 only, by the original designation of Pervinquière 1907, p. 322.

Fagesia tevesthensis (Péron, 1896)
(Text-fig. 22D)

1896. *Mammites*? *tevesthensis* Péron, p. 23, pl. 1 (7), figs 2, 3.
1907. *Fagesia Thevestensis* (Péron); Pervinquière, p. 325, pl. 20, figs 5, 6; text-figs 123, 124.
1939. *Fagesia thevestensis* Péron; Basse, p. 49.



Text-fig. 21. A-C – *Spathites* (*Jeanrogericeras*) *revelerianus* (Courtiller, 1860), FSIT A2, from the Marnes inférieures de Saint-Louis. D, E – *Spathites* (*Jeanrogericeras*) *combesi* (d'Orbigny, 1856), FSIT FR11, from La Ferrière (Padern area). All figures are × 1

1994. *Fagesia teveshtensis* (Péron, 1896); Kennedy, p. 261, pl. 7, figs 1–4; pl. 9, figs 6, 7.
1994. *Fagesia tevesthensis* (Péron, 1896); Chancellor *et al*., p. 62, pl. 15, figs 1–3, 10, 11 (with synonymy).
2009. *Fagesia tevesthensis* (Péron, 1896); Barroso-Barcenilla and Goy, p. 25, text-figs 4.4, 5.1 (with synonymy).
2014. *Fagesia tevesthensis* (Péron, 1896); Amédro and Devalque *in* Robaszynski *et al*., p. 145, pl. 10, fig. 2.

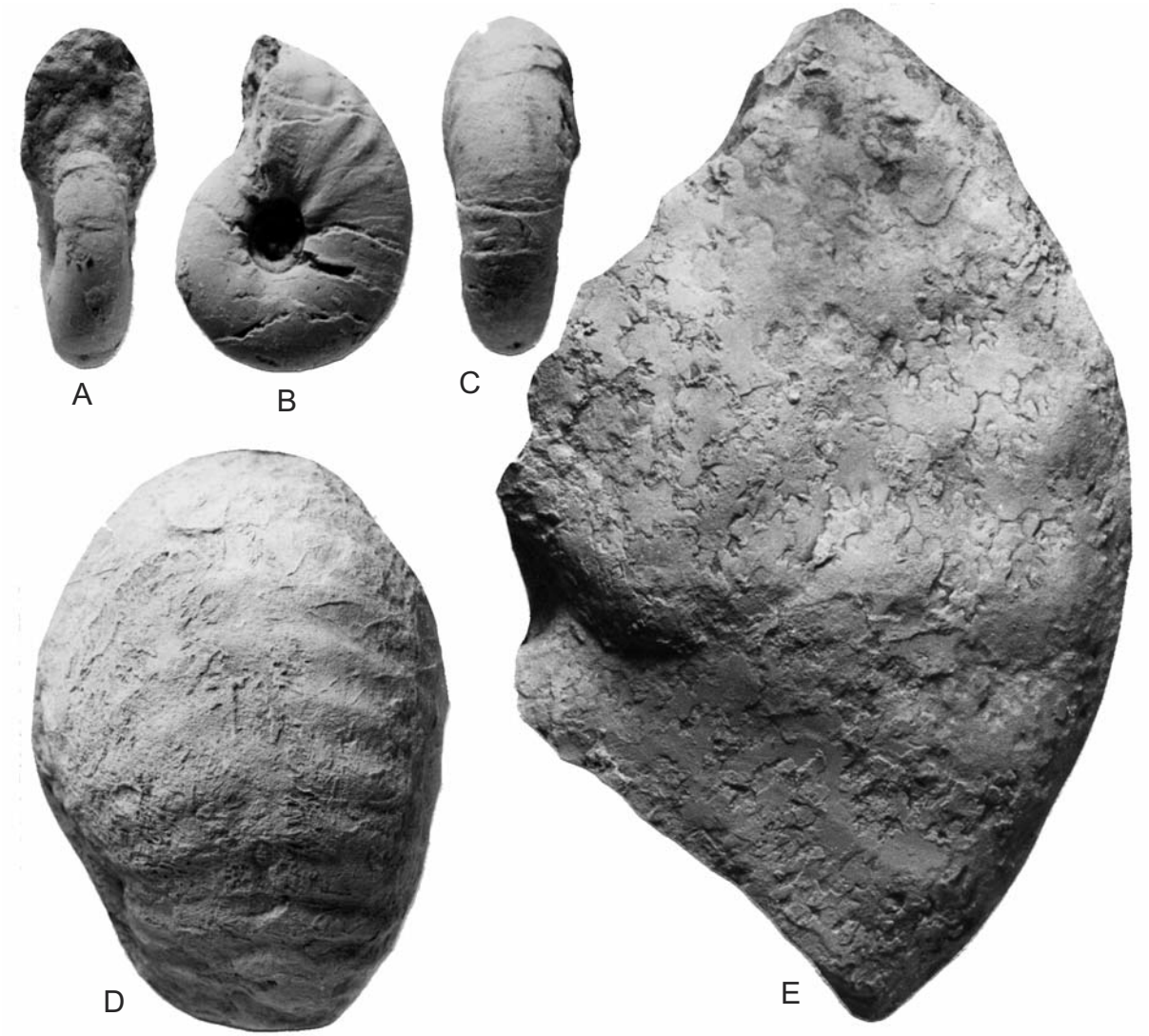
TYPE: The holotype, by monotypy, is MNHP F–J04308, the original of Péron 1896, pl. 1(7), figs 2, 3, from Tebessa, Algeria. It was refigured by Chancellor *et al*. 1994 (pl. 15, figs 10, 11).

MATERIAL: UM Sen015, from "entre les ruisseaux de la Tartière et du Barthas" (Basse, 1939, p. 49).

DISCUSSION: The specimen is a worn and battered phragmocone 70 mm in diameter. There are traces of coarse umbilical bullae that give rise to pairs of low, straight prorsiradiate blunt ribs, and long intercalated ribs on the flanks. They are better preserved on the venter, which they cross in a broad convexity. Poor as it is the specimen compares well with the holotype. The species is comprehensively reviewed by Chancellor *et al*. (1994).

OCCURRENCE: Lower Turonian, Gard and Aude in France, northern Spain, Portugal, Algeria, Tunisia, Egypt, Israel, and Japan. Renz (1982) recorded *Fagesia* cf. *thevestensis* (*sic*) from Venezuela.

Fagesia sp. juv.
(Text-fig. 23 A–C, G–I)



Text-fig. 22. A-C – *Romaniceras* (*Romaniceras*) sp. juv., FSIT MSSP4, from Marsa (Padern area). D – *Fagesia tevesthensis* (Péron, 1896), UM Sen015, from "entre les ruisseaux de la Tartière et du Barthas". E – *Coilopoceras springeri* Hyatt, 1903, FSIT RD1, from Marsa. Figures A–C are x3; figure D is x1; figure E is × 0.8

Text-fig. 23. A-C, G-I – *Fagesia* sp. juv. A-C – FSIT MSSP2, from SW of Marsa (Padern area); G-I – MSNP2, from NE of Marsa. D-F – *Vascoceras* sp. juv., FSIT MSSP6, from SW of Marsa. J-M – *Neoptychites cephalotus* (Courtiller, 1860). J, K – UM Sen010a; L, M – UM SEN010b, both from the environs of Padern: "coupe entre le ruisseau de la Tartière et du Barthas." Figures A–I are x5; figures J–M are × 1

MATERIAL: FSIT MSSP2 , FSIT MSNP2 from Marsa (Padern area).

DESCRIPTION: FSIT MSSP2 (Text-fig. 23A–C) is a limonitic nucleus encrusted in matrix, with a maximum preserved diameter of 8.7 mm. Coiling is very involute, the umbilicus deep and conical, the umbilical wall flattened and outward-inclined. The umbilical shoulder is narrowly rounded; there are no flanks. The venter is broad and convex. Eight conical tubercles perch on the umbilical shoulder of the adapertural half whorl. There are three deep constrictions on the outer whorl. They are deeply incised into the umbilical shoulder, and sweep forwards across the venter to form an obtuse chevron, flanked by adapical and adapertural collar ribs. FSIT MSNP2 (Text-fig. 23G–I) is a better–preserved individual 8.3 mm in diameter, with a whorl breadth to height ratio of 1.70, with four prominent constrictions on the outer whorl.

DISCUSSION: These tiny specimens share sufficient features with larger specimens of *Fagesia* such as that figured by Renz (1982, pl. 22, fig. 15) to confirm their generic assignation.

OCCURRENCE: As for material.

Genus *Neoptychites* Kossmat, 1895

TYPE SPECIES: *Ammonites telinga* Stoliczka, 1865, p. 125, pl. 62, figs 1, 2, by the subsequent designation of Solger (1904, p. 105); = *Ammonites cephalotus* Courtiller, 1860 (p. 248, pl. 2, figs 1–4).

Neoptychites cephalotus (Courtiller, 1860) (Text–figs 20A, 23J–M)

1860. *Ammonites cephalotus* Courtiller, p. 248, pl. 2, figs 1–4.
1939. *Neoptychites cephalotus* Court.; Basse, p. 47. text-fig. 2a, b.
1983. *Neoptychites cephalotus* (Courtiller); Cobban and Hook, p. 14, pl. 3, figs 9–11; pls 9–12; text-fig. 9 (with synonymy).
1994. *Neoptychites cephalotus* (Courtiller, 1860); Chancellor *et al.*, p. 70, pl. 16, figs 1–9; pl. 17, figs 1–5; pl. 18, figs 1–3; pl. 26, figs 2–4 (with synonymy).
2008. *Neoptychites cephalotus* (Courtiller, 1860); Kennedy *et al*., p. 159, pl. 3, figs 6–8; pl. 6, figs 1–5.
2009. *Neoptychites cephalotus* (Courtiller, 1860); Barroso-Barcenilla and Goy, p. 34, text–figs 9.4–6, 10.1–3 (with synonymy).
2010. *Neoptychites cephalotus* (Courtiller, 1860); Nagm *et al*., p. 489, text–figs 11g–h; 12a–b; 13a–b.
2012. *Neoptychites* gr. *cephalotus* (Courtiller, 1860); Meister and Adallah, p. 440, pl. 15, figs 1, 2; pl. 16, figs 1–3; pl.18, fig. 2 (with synonymy).

TYPES: The lectotype, by subsequent designation of Kennnedy and Wright (1979b, p. 674), is the original of their pl. 83, figs 1–3, no. CS631 in the collections of the Château de Saumur (Touraine, France). There are three additional surviving paralectotypes. All are inferred to be from the Middle Turonian Tuffeau de Saumur in the environs of Saumur.

MATERIAL: UM Sen010a, b, from the "region de Padern, coupe entre le ruisseau de la Tartière et du Barthas". FSIT FR4, 5, 13, from La Ferriere (Padern area).

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
UM Sen010a	73.2(100)	25.5(34.8)	42.5(58.0)	0.6	5.5(7.5)

DESCRIPTION: The best–preserved specimens are two juveniles in the Senesse Collection. UM Sen010a (Text-fig. 23J, K) is largely phragmocone, 73.2 mm in diameter, the last few septa crowded, and a possible adult microconch. Coiling is very involute, with a tiny umbilicus that comprises 7.5% of the diameter, deep, with a narrowly rounded umbilical shoulder. The whorl section is rounded-trigonal, with a whorl breadth to height ratio of 0.6, the greatest breadth just outside the umbilical shoulder, the inner flanks broadly convex, the outer flanks flattened and convergent, the ventrolateral shoulders rounded, the very narrow umbilicus very feebly convex. The inner flanks are smooth, the outer flanks with faint, low, broad, radial folds, an estimated 12 per half whorl. The suture (Text-fig. 20A) is quite deeply incised, with an asymmetrically bifid E/A, deep A and relatively large bifid A/U2. UM Sen010b (Text-fig. 23L, M) is a slightly stouter, but otherwise comparable individual 82 mm in diameter. FSIT FR4, a whorl fragment with a maximum preserved whorl height of 125 mm is interpreted as a part of a macroconch.

DISCUSSION: the present material, atlhough poor and slight, falls well within the range of populations of well-preserved material from the Lower Turonian *Mammites nodosoides* Zone of New Mexico (Cobban and Hook 1983, p. 14, pl. 3, figs 9–11; pls 9–12; text-fig. 9), and Tunisia (Chancellor *et al*. (1994, p. 70, pl. 16, figs 1–9; pl. 17, figs 1–5; pl. 18, figs 1–3; pl. 26, figs 2–4).

OCCURRENCE: The species first occurs in the Lower Turonian *Thomasites rollandi* Zone in Tunisia and the *Vascoceras birchbyi* Zone in New Mexico, and extends to the lower part of the Middle Turonian *Collignoniceras woollgari* Zone in France. The geographic range is France, Spain, Morocco, Algeria, Tunisia, Egypt, Israel, Syria, Cameroon, Madagascar, southern India, Colorado, New Mexico and Trans-Pecos Texas in the United States; northern Mexico, Trinidad, Venezuela, Colombia, Brazil, Niger and Nigeria.

Family Pseudotissotidae Hyatt, 1903
Subfamily Pseudotissotinae Hyatt, 1903
(=Hemitissotinae Parnes, 1964, Hourquiidae Renz, 1982)
Genus *Pseudotissotia* Peron, 1897
(=*Bauchioceras* Reyment, 1954b; *Furoniceras* Collignon, 1957)

TYPE SPECIES: *Ammonites galliennei* d'Orbigny, 1850, by original designation.

Pseudotissotia galliennei (d'Orbigny, 1850)
(Text-fig. 19B, C)

1850. *Ammonites galliennei* d'Orbigny, p. 190.
1979. *Pseudotissotia galliennei* (d'Orbigny); Kennedy *et al*., p. 6, text-figs 1–20, 23, 24, 28–30 (with full synonymy).
2006. *Pseudotissotia gallienei* (d'Orbigny, 1850); Bert *et al*., pl. 2, fig. 3.
2007a. *Pseudotissotia gallienei* (d'Orbigny, 1850); Bert, p. 38, text-fig. 7.

TYPE: The holotype, by monotypy, is MNHP F-A25659, d'Orbigny Collection 6776, from the Turonian of Poncé, Sarthe, France. It was figured by Kennedy *et al*. 1979, figs 1–3.

MATERIAL: FSIT MC5 from the Calcaires de Montplaisir; FSIT MC 16, from the Saint-Louis syncline.

DESCRIPTION: FSIT MC5 (Text-fig. 19B, C) is 116 mm in diameter, and in part body chamber, although the position of the final septum cannot be established. The umbilicus comprises an estimated 16.4% of the diameter, and is shallow, with a flattened wall and narrowly rounded to subangular umbilical shoulder. The whorl section is compressed, with feebly convex inner to mid-flanks and flattened, convergent outer flanks in intercostal section, the ventrolateral shoulders narrowly rounded, the venter flat, with three strong, rounded keels separated by deep grooves. Broad ribs arise either singly or in pairs at the umbilical shoulder, in some cases from broad incipient bullae, and are straight and recti- to feebly rursirsdiate on the flanks. They extend to the lateral keels. FSIT MC16 is a very worn individual with a maximum preserved diameter of 117 mm. An estimated eight low, broad, incipient umbilical bullae give rise to pairs of low, broad, flat ribs. The lateral ventral keels are feebly undulose, the undulations corresponding to the points where the ribs intersect the keels.

DISCUSSION: Poorly preserved as they are, the specimens conform with the holotype and other specimens from Sarthe figured by Kennedy *et al.* (1979). *Pseudotissotia faustinlebachae* Bert, Perés and Marchand, 2006 (p. 3, pl. 1, figs 1, 2; pl. 2, figs 1, 2), from the base of the Middle Turonian *Collignoniceras woollgari regulare* Subzone of Viennne ,was differentiated from the present species on the basis of the presence of large umbilical tubercles and clavi on the ventrolateral keels of the phragmocone.

OCCURRENCE: Middle Turonian, Sarthe, Lot-et-Garonne, and the southern Corbières, Aude, in France

Genus *Thomasites* Pervinquière, 1907
(=*Gombeoceras* Reyment, 1954b; *Koulabiceras* Atabekian, 1966; *Ferganites* Stankievitch and Pojarkova, 1969)

TYPE SPECIES: *Pachydiscus rollandi* Thomas and Péron, 1889, p. 25, pl. 17, figs 1–3, by the subsequent designation of Diener 1925, p. 103.

Thomasites rollandi (Thomas and Péron, 1889)
(Text-fig. 24A, B)

1889. *Pachydiscus rollandi* Thomas and Péron, p. 25, pl. 17, figs 1–3.
1994. *Thomasites rollandi* (Thomas and Péron, 1889); Chancellor *et al*., p. 75, pl. 19, figs 1, 2; pl. 20, figs 1–12; pl. 21, figs 1–9; pl. 22, figs 1–6; pl. 23, figs 1–9; Text-fig. 14a–f (with synonymy).
2007b. *Thomasites rollandi* (Thomas and Péron, 1889); Bert, p. 34, text-figs 2–4.
2012. *Thomasites rollandi rollandi* (Thomas and Péron, 1889); Meister and Abdallah, p. 441, pl. 17, fig. 1 (with additional synonymy).
2012. *Thomasites rolllandi* forme *jordani* Pervinquière, 1907; Meister and Abdallah, p. 441, pl. 17, figs 2, 3 (with additional synonymy).

TYPE: The holotype, by monotypy, is MNHP R5205, the original of Thomas and Péron 1889, p. 25, pl. 17, figs 1–3, from Djebel Guelb, Algeria. It was refigured by Chancellor *et al*. 1994, pl. 19.

MATERIAL: FSIT MSN20, from Marsa (Padern area).

DESCRIPTION: The specimen is a worn internal mould of a phragmocone 75.6 mm in diameter. Coiling is very involute, the umbilicus, plugged by matrix, has an estimated diameter of 9%. The whorl section is compressed, with a whorl breadth to height ratio of 0.9, the greatest breadth at the umbilical shoulder, the inner flanks broadly rounded, the middle and outer flanks broadly convex to flat, converging to broadly rounded ventrolateral shoulders and a feebly convex venter in intercostal section. The inner flanks are smooth, but low ribs appear on the outer flanks and develop into blunt ventrolateral bullae, 14 on the adapical half of the outer whorl, linked over the venter by a broad, transverse rib.

DISCUSSION: The present specimen corresponds to *Thomasites jordani* of Pervinquière, 1907, a synonym of *rollandi*, specifically the original of his pl. 22, fig. 10, refigured by Chancellor *et al*. (1994, pl. 21, figs 7–9), who comprehensively review the species.

OCCURRENCE: Lower Turonian, index of the *Thomasites jordani* Zone of Central Tunisia, and extending into the succeeding *Mammites nodosoides* Zone according to Robasznski *et al.* (1990). The geographic distribution extends from Provence and Aude in France to northern Spain, Morocco, Algeria, Jordan, Syria, Israel, Lebanon, Egypt, Tadjikistan , and, perhaps, Colombia, and southern England.

Genus and subgenus *Choffaticeras* Hyatt, 1903

TYPE SPECIES: *Pseudotissotia meslei* Péron, 1897, p. 33, pl. 14 (1), fig. 1; pl. 15 (2), figs 1, 2; pl. 16 (3), fig. 2; pl. 11 (17), fig. 1, by the original designation of Hyatt 1903, p. 37.

Choffaticeras (*Choffaticeras*) *quaasi* (Péron, 1904) (Text-fig. 24D–F)

1904. *Schloenbachi quaasi* Peron *in* Fourtau, p 255, pl. 1, figs 1–3.

2007. *Choffaticeras* (*Choffaticeras*) *quaasi* (Péron, 1904); Barroso-Barcenilla and Goy, p. 464, text-figs 4.4, 4.5, 5.1 (with full synonymy).

TYPES: The status of Peron's material is uncertain, as it has not been traced.

MATERIAL: FSIT FR10, from La Ferriere (Padern area).

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
FSIT FR10	94.4(100)	–(–)	20.9(22.1)	–	8.5(9.0)

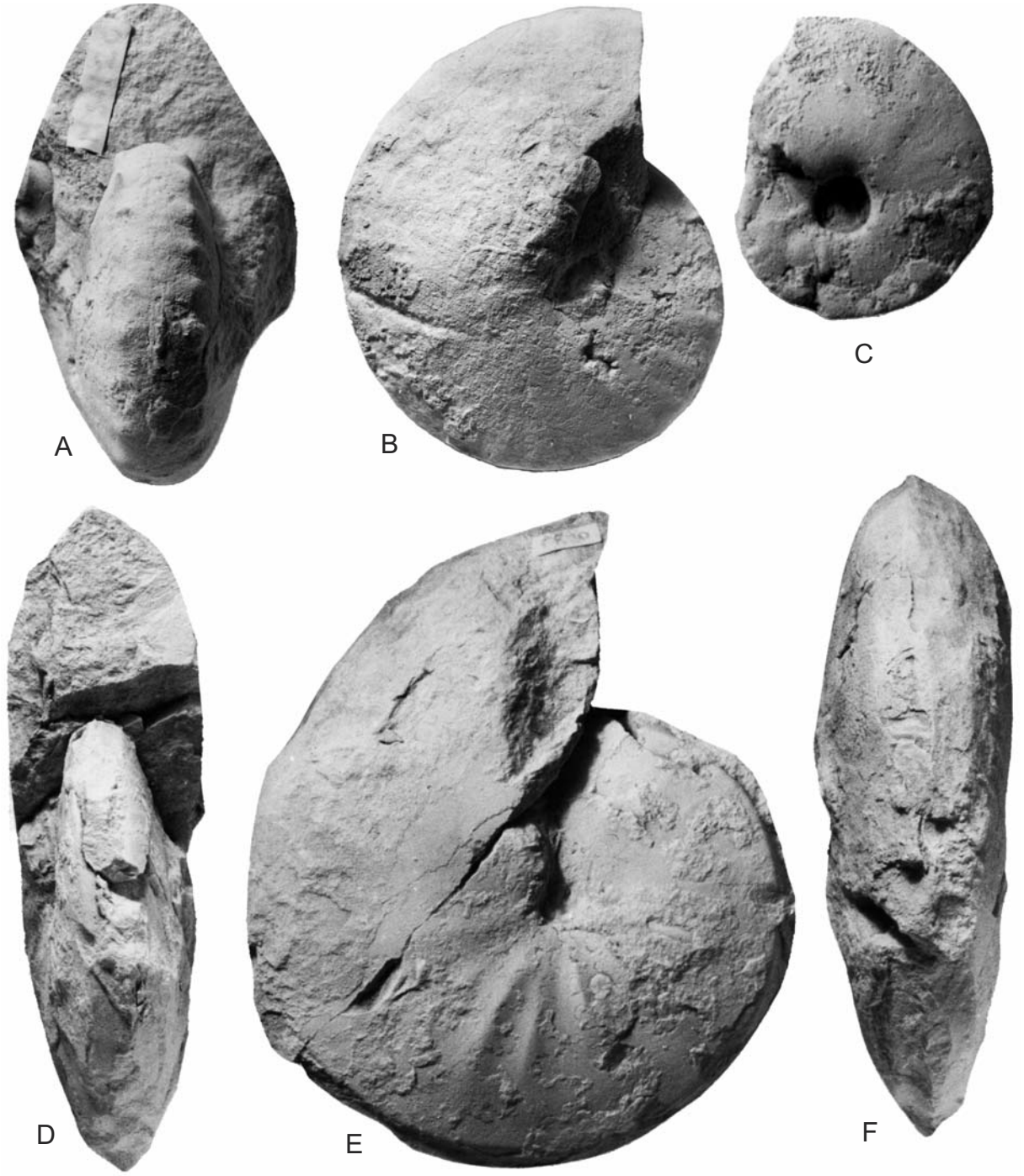
DESCRIPTION: The specimen is 117 mm in maximum preserved diameter, and badly worn on one flank. It is part body chamber, but the position of the final septum cannot be established. Coiling is very evolute, the tiny umbilicus comprising 9% of the diameter, with a flattened wall and narrowly rounded umbilical shoulder. The whorl section is very compressed, with a whorl breadth to height ratio of 0.53 approximately, the greatest breadth below mid-flank, the inner and middle flanks feebly convex, the outer flanks flattened, and convergent. There is a narrowly rounded, abrupt ventrolateral shoulder, separated by a distinctive concave zone from an acutely fastigiate venter with a high siphonal keel. The combination of concavities on either side of the siphonal keel and abrupt ventrolateral shoulders make the specimen appear to be feebly subtricarinate. Narrow primary ribs arise at the umbilical shoulder either singly or in pairs, and are straight to prorsiradiate across the flanks, strengthening to reach their maximum development at mid-flank before declining and effacing before they reach the ventrolateral shoulder. The suture is poorly exposed, the elements broad, plump, and moderately incised.

DISCUSSION: Relevent species of *Choffaticeras* are discussed by Chancellor *et al*. (1994) and Barroso-Barcenilla and Goy (2007). Of described material, the specimen is close to the original of *Pseudotissotia* (*Choffaticeras*) *segnis* Solger, 1903 var. *discoidalis* Pervinquière, 1907 (pl. 23, fig. 3; refigured by Chancellor *et al*. 1994, pl. 28, figs 3–5), itself a synonym of *quaasi.*

OCCURRENCE: Lower Turonian, Egypt, Israel, Tunisia, northwestern Spain, Provence and the southern Corbières in Aude, France.

Subgenus *Leoniceras* H. Douvillé, 1911

TYPE SPECIES: *Pseudotissotia* (*Choffaticeras) luciae* Pervinquière, 1907, p. 354, pl. 24, figs 1, 2; text-figs 135–137, by the original designation of H. Douvillé, 1911, p. 86.



Text-fig. 24. A, B – *Thomasites rollandi* (Thomas and Péron, 1889), FSIT MSN20, from NE of Marsa (Padern area). C – *Wrightoceras* sp. juv., the original of *Hoplitoides ingens* of Basse, 1939, UM Senesse Collection, from the "combe au N de Linas." D-F – *Choffaticeras quaasi* (Peron, 1904), FSIT FR10, from La Ferrière (Padern area). Figures A, B, D–F are × 1; figure C is × 4

Choffaticeras (*Leoniceras*) sp.
(Text-figs 16E, F; 25)

MATERIAL: FSIT MSN14, from the Padern area; FSIT M5, BS2 and MB600, from Baillesats.

DESCRIPTION: The material is poor, comprising a series of involute individuals with a compressed lanceolate whorl section and lacking ornament. They range from 77–134 mm in diameter. The best preserved specimen is FSIT M5 (Text-fig. 25), the largest specimen

Text-fig. 25. *Choffaticeras* (*Leoniceras*) sp., FSIT M5, from Baillesats. Figures are × 1

seen, a phragmocone. Coiling is very involute, the umbilicus comprising an estimated 10% of the diameter, deep, with a flattened umbilical wall and narrowly rounded umbilical shoulder. The whorl section is compressed lanceolate, with a whorl breadth to height ratio of 0.65 approximately. The inner to middle flanks are convex, the outer flanks converge to the acute venter. There is no ornament.

DISCUSSION: The material is too poor for specific identification. Of described species, it compares most closely with *Choffaticeras* (*Leoniceras*) *barjonai* (Choffat, 1898) (p. 73, pl. 3; pl. 18, fig. 3; pl. 20, figs 40–42), as revised by Barroso-Barcenilla and Goy (2007, p. 474, text-figs 7.5, 7.6; 9.1–4). Basse (1939, p. 51, pl. 3, fig. 13; text-fig. on p. 42, figs 6a–c) described and illustrated three specimens in the Senesse collection with diameters of between 115 and 130 mm from the southern Corbières that she assigned to *Pseudotissotia* (*Leoniceras*) *pavillieri.* We have not seen these specimens.

OCCURRENCE: As for material.

Genus *Wrightoceras* Reyment, 1954b
(= *Imlayiceras* Leanza, 1967)

TYPE SPECIES: *Bauchioceras* (*Wrightoceras*) *wallsi*, Reyment, 1954b, p. 160, pl. 2, fig. 4; pl. 3, fig. 3, by the original designation of Reyment, 1954b, p. 159.

Wrightocera wallsi Reyment, 1954b
(Text-figs 26; 20B)

1954b. *Bauchioceras* (*Wrightoceras*) *wallsi* Reyment, 1954, p. 160, pl. 2, fig. 4; pl. 3, fig. 3.
1983. *Wrightoceras wallsi* Reyment; Hirano, p. 70, pl. 5, figs 1–6 (with synonymy).
1987. *Wrightoceras wallsi* Reyment, 1954; Zaborski, p. 51, text-figs 36–37 (with synonymy).

Text-fig. 26. *Wrightoceras wallsi* Retment, 1954, FSIT MSN5b, from NE of Marsa (Padern area). Figures are reduced × 0.5; the original is 290 mm in diameter.

1989. *Pseudotissotia* (*Wrightoceras*) *wallsi* (Reyment, 1954a); Meister, p. 49, pl. 28, figs1–3.
1994. *Thomasites wallsi* (Reyment, 1954); Meister *et al*., p. 213, pl. 10, figs 2, 4; text-fig. 13.
2007b. *Wrightoceras wallsi* (Reyment, 1954); Bert, p. 40, text-figs 9, 10.

TYPE: The holotype, by original designation, is BMNH C47417, the original of Reyment 1954b, p. 160, pl. 3, fig. 3, from the Lower Turonian of Kanawa, Deba Habe, near Gombe, Bauchi Province, Nigeria.

MATERIAL: FSIT MSN5b, from Marsa (Padern area); FSIT FR3, from La Ferriere (Padern area).

DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
FSIT MSN5b	210 (100)		112 (53.3)	–	24.8 (11.8)

DESCRIPTION: FSIT MSN5b (Text-fig. 26) is a wholly septate internal mound with a maximum preserved diameter of 265 mm. Coiling is very involute, the tiny, deep umbilicus comprising 11.8% of the diameter. The whorl section is very compressed, with a whorl breadth to height ratio of 0.7, the greatest breadth just outside the umbilical shoulder. The inner flanks are broadly rounded, the outer flanks flattened and strongly convergent. The venter is narrow and very feebly convex, with sharp ventrolateral shoulders. The surface of the mould is smooth. FSIT FR3 is a

fragment with a maximum preserved whorl height of 70 mm approximately, and comparable to the previous specimen. The suture (Text-fig. 20B) has a broad, asymmetrically bifid E/A, very broad A, with phylloid accessory saddles, and a broad bifid A/U2 with minor incisions.

DISCUSSION: FSIT MSN5b exceeds in size the largest previously know *Wrightoceras wallsi*: that figured by Meister *et al*. 1994, pl. 15, fig. 2, which is just over 170mm in diameter, and in part body chamber, and those described by Hirano (1983), which are up to 250mm in diameter. The specimen is referred to *wallsi* on the basis of whorl proportions, whorl cross section, and lack of ornament. *Wrightoceras munieri* (Pervinquière, 1907) (p. 217, pl. 10, figs 1, 2; text-fig. 83; see revisions in Chancellor *et al*., 1994 (p. 96, pl. 26, figs 1, 5, 8; pl. 28 figs 1, 4; pl. 28, figs 2, 3; pl. 29 figs 3–8; pl. 36, figs 1, 2; text-figs 18g, h; 19h, i) and Barroso-Barcenilla and Goy, 2007 (p. 480, text-fig. 10.3, 4) is much more compressed, with whorl breadth to height ratios of 0.4 to 0.55. *Wrightoceras llareni* (Karrenberg, 1935) (p. 143, pl. 31, fig. 14; pl. 33, fig. 14; see revision in Barroso–Barcenilla and Goy 2007, p. 478, text-fig. 10.1, 2) is based on two specimens, of which one was figured. It is much smaller than the present specimen, but differs from comparably sizes *wallsi* described by previous authors in having strong umbilical bullae, flank ribs, and a concave outer flank region in section. A small specimen referred to the species by Barroso-Barcenilla and Goy (2007, text-fig. 10. 1, 2) has small clavi on the ventrolateral shoulder. *Wrightoceras submunieri* Wiedmann, 1975 (p. 145, pl. 3, fig. 2) (see revision in Barroso-Barcenilla and Goy 2007, p. 481, fig. 10.5) also based on smaller specimens, has coarse radial ribs and ventrolateral clavi.

OCCURRENCE: Lower Turonian, Nigeria, Niger, and the southern Corbières, Aude, France.

Wrightoceras sp.
(Text-fig. 24C)

1939. *Hoplitoides* sp. juv. cf. *ingens* v. Koenen emend. Solger; Basse, p. 52.

MATERIAL: The original of *Hoplitoides* sp. juv. cf. *ingens* of Basse, 1939, p. 52, Université de Montpellier, Sénesse Collection, from the "combe au N de Linas".

DESCRIPTION AND DISCUSSION: The specimen is a limonitic internal mould 12.5 mm in diameter. Coiling is very involute, the shallow umbilicus comprising 18% approximately of the diameter, the umbilical wall low and flattened, the umbilical shoulder narrowly rounded. The whorl section is very compressed, with feebly convex inner flanks and flattened, convergent outer flanks. The venter is narrow and concave between sharp ventrolateral shoulders. The surface of the mould is smooth but for low, broad widely separated folds, best developed on the inner to middle flank. The suture is partially exposed, with an incompletely preserved E/A, a broad shallow A with only minor incisions, and a small A/U2.The specimen is specifically indeternminate. It differs from *Wrightoceras wallsi*, described above, in its much more compressed whorl section, and is closer to *Wrightoceras munieri*, resembling to a degree, the smallest specimen figured by Kennedy *et al*.(2008, pl. 7, fig. 3).

OCCURRENCE: As for material.

Family Collignoniceratidae Wright and Wright, 1951

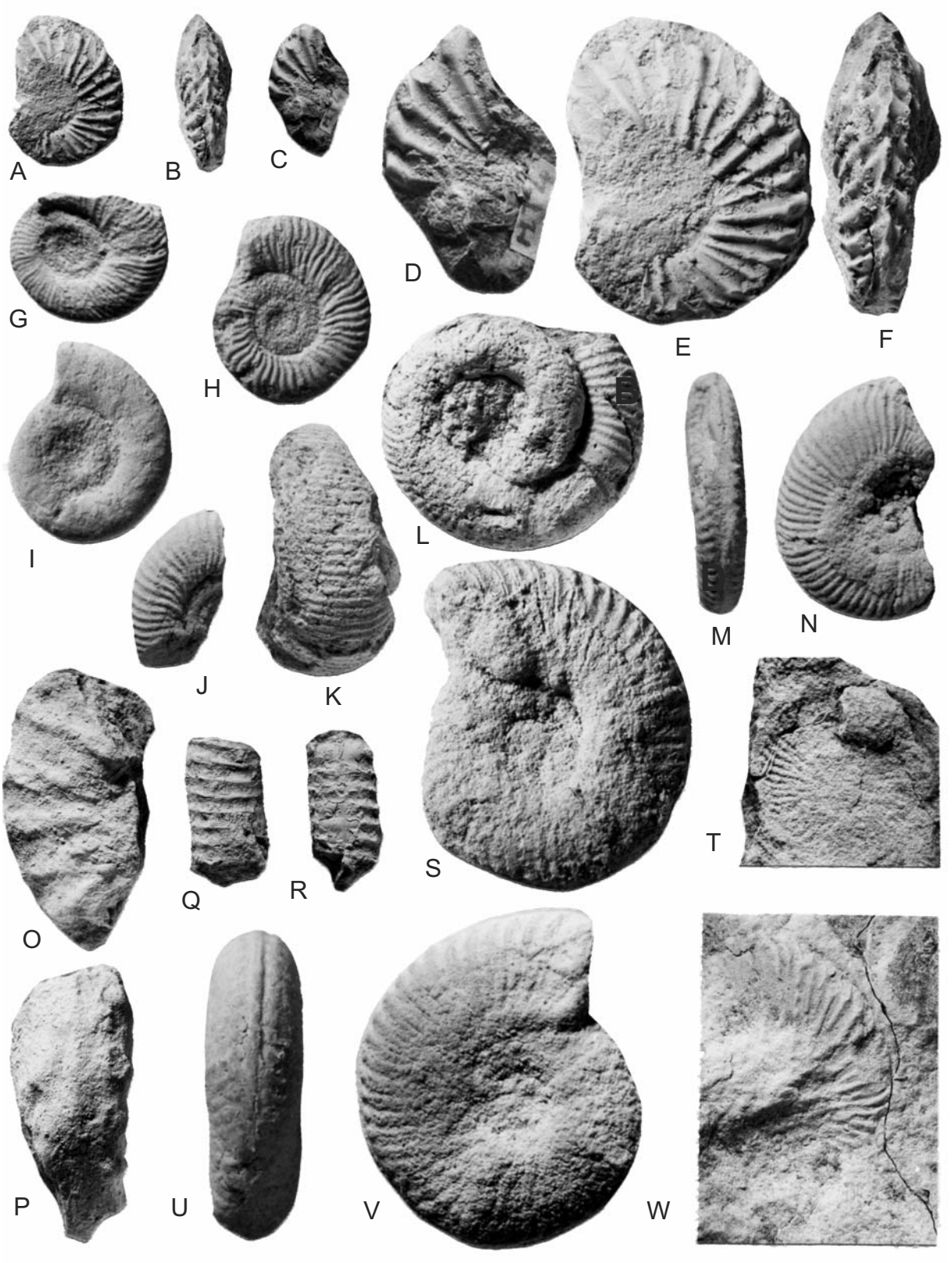
Subfamily Collignoniceratinae Wright and Wright, 1951

Genus *Collignoniceras* Breistroffer, 1947
(ICZN, 1968, Opinion 861, name no. 1798; *pro Prionotropis* Meek, 1876, p. 453, *non* Fieber, 1853, p. 127; = *Selwynoceras* Warren and Stelck, 1940, p. 151; *non Collignoniceras* Van Hoepen, 1955, p. 361.)

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 proposed *Collignoniceras* as *nomen novum*.

Collignoniceras woollgari (Mantell, 1822) *sensu lato*
(Text-fig. 27A–F)

Text-fig. 27. **A-F** – *Collignoniceras woollgari* (Mantell, 1822) *sensu lato*. A, B, E, F, FSIT MT2; C, D, FSIT MT4, both from the Calcaires de Montplaisir (Saint-Louis syncline). **G, H, J, M, N, S,U, V** – *Subprionocyclus* sp. juv. G, FSIT PP2; H, FSIT PP3; J, FSIT PP1; M, N, FSIT PP4; S, U, V, FSIT PP5, all from the Marnes supérieures de Saint-Louis . J, *Worthoceras* cf. *rochatianum* (d'Orbigny, 1850), FSIT PP11, from the Marnes supérieures de Saint-Louis. **K, L** – *Eubostrychoceras saxonicum* (Schlüter, 1875), MC7, from the Calcaires de Montplaisir (Saint-Louis syncline). **O, P** – *Kamerunoceras* sp., FSIT MC2/1, from the Marnes inférieures de Saint-Louis. **T, W** – *Prionocyclus* sp. T, FSIT MC12b, W, FSIT MC20, from the Marnes supérieures de Saint-Louis. **Q, R** – *Allocrioceras* sp., FSIT DS2, from Le Devès (Padern area). Figures A–C, O-R are x1; T, W, are × 1.5; figures D–F, K-L, are × 2; figures G–J, M, N, S, U, V, are × 5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1822. *Ammonites woollgari* Mantell, p. 197, pl. 21. fig. 16; pl. 22, fig. 7.
1946. *Prionotropis woollgari* (Mantell) and varieties; Haas, p. 150 (*pars*), pls 11, 12; pl. 13, figs 1–3, 5–18, *non* 4, 19; pl. 14, figs 1–10; pl. 16, figs 1–21, *non* 22–33; *non* pl. 17; pl. 18, figs 1, 3–7, *non* 8, 9; text-figs 1–4, 6–14, 19–83, 91.
2001. *Collignoniceras woollgari woollgari* (Mantell, 1822); Kennedy *et al*., p. 45, figs 10–15 (with synonymy).
2001. *Collignoniceras woollgari regulare* (Haas, 1946); Kennedy *et al*., p. 45, figs 17–33, 49l (with full synonymy).
2014. *Collignoniceras woollgari regulare* (Haas, 1946); Amédro and Devalque *in* Robaszynski *et al*., p. 150, pl. 19, fig. 1; pl. 25, fig. 1; pl. 26, fig. 1.
2014. *Collignoniceras woollgari woollgari* (Mantell,1822); Amédro and Devalque *in* Robaszynski *et al*., p. 150.

TYPES: The lectotype of *Collignoniceras woollgari woollgari* is BMNH C5682, the original of Mantell, 1822, pl. 21, fig. 16, from the Middle Chalk near Lewes, Sussex, England, by the subsequent designation of Wright and Wright, 1951, p. 35. Presumed paralectotypes are BMH C5742a, b, from the same locality. The holotype, by original designation, of *Collignoniceras woollgari regulare* is no. 1470 in the collections of the South Dakota School of Mines, the original of Haas, 1946, pl. 16, figs 14, 16; text-figs 80, 81, from an unknown horizon and locality in the Black Hills of South Dakota.

MATERIAL: FSIT MT2 and MT4, from Calcaires de Montplaisir, Saint-Louis syncline.

DESCRIPTION: FSIT MT2 (Text-fig. 27A, B, E, F) is a well-preserved juvenile with a maximum preserved diameter of 29 mm. Coiling appears to have been moderatly evolute, the umbilicus shallow, the whorl section compressed with a costal whorl breadth to height ratio of 0.84. There are fourteen ribs, all primaries, on the adapertural half of the outer whorl. They arise at the umbilical seam, and are incipiently bullate on the umbilical shoulder, straight and prorsiradiate across the flanks, strengthening progressively, and linking to a small inner ventrolateral clavus from which a broad rib sweeps forwards and links to a stronger outer ventrolateral clavus. A broad, prorsiradiate rib extends to a strong continuous siphonal keel, forming an obtuse chevron. The keel is strengthened into sharp clavi at the apex of the chevron, so that the keel is markedly undulose in profile. FSIT MT4 (Text-fig. 27C, D) is a 90° whorl sector of an individual of comparable size and ornament.

DISCUSSION: *Collignoniceras woollgari woollgari* is the early form of the species. It differs from *C. woollgari regulare* (Haas, 1946), in having more siphonal tubercles than ventrolateral ones on the middle and later phragmocone whorls, and looped ribs connecting opposite ventrolateral horns over the venter. These features generally separate body chambers, although they may occur on some body chambers of *C. woollgari regulare.* The present juvenile specimens cannot be assigned to one or other subspecies with any confidence.They compare well with the inner whorls of BMNH 5742a, a paralectotype of *woollgari woollgari* (Wright and Kennedy, 1981, pl. 29, fig. 6)

OCCURRENCE: Middle Turonian *Collignoniceras woollgari* Zone. There are records from southern England, France, southern Belgium, Germany, The Czech Republic, Austria, Bulgaria, Spain, east-central Iran, Turkmenistan, the US Western Interior from northern Montana to Trans-Pecos Texas, and central Utah to western Iowa; northeast Texas, California, Oregon, Manitoba in Canada, and Chihuahua in Mexico, Japan and Bathurst Island, Northern Australia

Genus *Prionocyclus* Meek, 1876
(= *Germariceras* Breistroffer, 1947)

TYPE SPECIES: *Ammonites serratocarinatus* Meek, 1871, p. 298, *non* Stoliczka, 1865, p. 57, pl. 32, fig. 3; = *Prionocyclus wyomingensis* Meek, 1876, p. 452.

Prionocyclus sp.
(Text-fig. 27T, W)

MATERIAL: FSIT MC2, 12a, b, 20, from the Saint-Louis syncline.

DESCRIPTION: FSIT MC12a, b (part and counterpart) comprise a nucleus 19 mm in diameter, reduced to a mere film. Coiling appears to have been moderately involute, the expansion rate low. Ornament is of crowded wiry primary ribs that arise in pairs from tiny umbilical bullae, and long intercalated ribs. The ribs are prorsirsdiate, and flex forwards on the ventrolateral shoulder. FSIT MC20 (Text-fig. 27W) is an internal mould of a larger fragment of flank, with a maximum preserved whorl height of an estimated 30mm. Crowded wiry primary ribs arise in pairs from small umbilical bullae, with additional long intercalated ribs, as in the previous specimen. The ribs are straight on the inner to mid-flank before flexing forwards, concave on the outer flank and

ventrolateral shoulder, where they link to tiny ventrolateral clavi. There are indications of a siphonal keel.

DISCUSSION: Although poor fragments, the wiry ribbing of these specimens, together with such as is visible of tuberculation and keel separate them from both *Collignoniceras* and *Subprionocyclus* species recorded from Europe. There are clear comparisons with juvenile *Prionocyclus albinus* (Fritsch, 1872) (p. 28, pl. 6, fig. 4; see revision in Kennedy *et al*. 2001, p. 93, text-figs 62, 108c), a species originally described from the Turonian of Wehlovice in the Czech Republic. They are close to a juvenile figured by Kennedy *et al*. 2001, text-fig. 62n, o, from the MiddleTuronian *Prionocyclus hyatti* Zone of Carbon County, Utah.

OCCURRENCE: As for material.

Genus *Subprionocyclus* Shimizu, 1932
(= *Reesidites* Wright and Matsumoto, 1954 p. 130; *Oregoniceras* Anderson, 1958, p. 263; 1943, p. 185, *nom, nud*.; *Ledoceras* Basse, 1963, p. 87)

TYPE SPECIES: *Prionocyclus hitchinensis* Billinghurst, 1927, p. 516, pl. 16, figs 1, 2, by the original designation of Shimizu 1932, fig. 2.

Subprionocyclus sp. juv.
(Text-fig. 27G, H, J, M, N, S, U, V)

MATERIAL: FSIT PP1–10, from the Saint-Louis syncline.

DESCRIPTION: A series of tiny limonitic nuclei range from 6.2–12.7 mm in diameter. Coiling is evolute, the shallow umbilicus comprising over 40% of the diameter, with a low, rounded umbilical wall. The whorl section is compressed, with feebly convex subparallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter with a sharp siphonal keel. Crowded fine ribs arise either singly or in pairs from tiny bullae, perched on the umbilical shoulder. Additional long ribs intercalate in some specimens. The ribs are straight and prorsirsdiate at the umbilical shoulder, flexing back and feebly convex at and below midflank, then flexing forwards and feebly concave on the outer flank, where they link to a single row of tiny ventrolateral/ventral clavi. A narrow smooth zone separates the clavi from a serrated siphonal keel, strengthened into minute clavi that correspond to the ventrolateral/ventral row.

DISCUSSION: The distinctive features of these minute nuclei are the evolute coiling, flexuous ribs, and presence of only a single row of ventral/ventrolateral clavi, the last a feature they share with the types pecies, *Subprionocyclus hitchinensis*, the holotype of which (Billinghurst 1927, pl. 16, fig. 1) is much more involute, high-whorled, and even more densely ribbed. There are closer comparisons to the lower Upper Turonian *Subprionocyclus bravaisianus* (d'Orbigny, 1841) (p. 308, pl. 91, figs 3, 4), from Uchaux, Vaucluse. The lectotype and paralectotypes are figured by Matsumoto and Noda (1966, p. 359, pl. 40, figs 1–6), Kennedy and Juignet *in* Gauthier 2006 (p. 112, pl. 60, figs 3, 4), and a series of topotypes by Roman and Mazeran (1913, pl. 1, figs 13–15) and Amédro and Devalque (*in* Robaszynski *et al*. 2014, pl. 39, figs 1–8). The lectotype (Matsumoto and Noda 1966 , pl. 40. fig. 1; Kennedy and Juignet *in* Gauthier pl. 60, fig. 3) is 15.5 mm in diameter, and thus slightly larger than the largest of the present specimens, a little more involute and higher-whorled, and has both inner and outer ventrolateral tubercles. We leave these tiny specimens in open nomenclature at this time.

OCCURRENCE: As for material.

Family Coilopoceratidae Hyatt, 1903
Genus *Coilopoceras* Hyatt, 1903
(=*Namadoceras* Vredenberg, 1907, p. 121; *Glebsoceras* Reyment, 1954b, p. 161; *Vredenbergia* Chiplonkar and Ghare, 1976, p. 7)

TYPE SPECIES: *Coilopoceras colleti* Hyatt, 1903, p. 91, pl. 10, figs 5–21; pl. 11, fig. 1, by the original designation of Hyatt 1903, p. 91.

Coilopoceras springeri Hyatt, 1903
(Text-figs 20C, D; 28H, I, N–P; 29)

1903. *Coilopoceras Springeri* Hyatt, p. 96, pl. 12, figs 1–3.
1980. *Coilopoceras springeri* Hyatt; Cobban and Hook, p.16, pl. 1, figs 5, 6; pl. 3, figs 9–11; pl. 6, figs 9, 10; pl. 10; pl. 18, figs 7–10; pl. 19, figs 1–9; text-figs 11–13 (with synonymy).
1988. *Coilopoceras springeri* Hyatt, 1903; Kennedy, p. 92, pl. 13, figs 4–7; text-figs 24h, 33, 34.
1989. *Coilopoceras springeri* Hyatt, 1903; Kennedy *et al*., p. 94; text-figs 27x, y, 28–30, 31m, n, w, x.
?2014. *Coilopoceras* cf. *springeri* Hyatt, 1903; Amédro and Devalque, *in* Robaszynski *et al*., p. 160, pl. 34, fig. 1.

TYPE: The holotype, by monotypy, is the original of

Hyatt, 1903, p. 96, pl. 12, figs 1–3, from Rio del Plano [Rit du Plain] in Colfax County, New Mexico.

MATERIAL: FSIT MS 5 and 6, and FSIT RD 1, from the Padern area ; FSIT MC3, from the Saint-Louis syncline; FSIT RE II and III, from Rennes-les-Bains.

DESCRIPTION: FSIT MS6 (Text-fig. 28H, I) is an oxycone with a maximum preserved diameter of 56 mm. The inner flanks are feebly convex, the outer flanks flattened, and converging to a narrowly rounded venter on the internal mould. Primary ribs arise just outside the umbilical shoulder; intercalated ribs arise low on the inner flank, where they are very weak. The ribs are straight and prorsirsdiate on the inner flank, strengthening progressively and broadening on the outer flank, where they are feebly concave, and decline before reaching the venter. FSIT MC3 (Text-fig. 28D, E) is 37.6 mm in maximum preserved diameter. The penultimate whorl has a very narrow feebly convex venter. The ornament of the outer whorl is as in the previous specimen, but relatively stronger. FSIT REII (Text-fig. 28N, O) is an internal mould of a smooth oxycone phragmocone fragment with an estimated maximum whorl height of 55 mm and whorl breadth to height ratio of 0.38, the greatest breadth below mid-flank. FSIT MS5 retains recrystallised shell and is again smooth, with a maximum preserved whorl height of 60 mm and whorl breadth to height ratio of 0.48. FSIT RE III (Text-fig. 28P) is a phragmocone with a maximum preserved whorl height of 44.7 mm and a whorl breadth to height ratio of 0.47. In contrast to the previous specimens, there is a well-developed ornament. Three blunt umbilical bulges per half whorl give rise to low, broad, straight ribs, either singly or in pairs, with additional single primaries arising at the umbilical shoulder, while there are occasional shorted intercalated ribs. The ribs are strongest at mid-flank, and weaken markedly on the outer flank. FSIT RD 1 (Text-fig. 22E) is a huge 120° whorl fragment of the ribbed variant of the species with a maximum preserved whorl height of 190 mm. One flank is worn away; the other is well-preserved, with three massive umbilical bulges that correspond to six broad, low swellings on the ventrolateral shoulder, separated from the fastigiate venter by a narrow, smooth zone. FSIT MB579 (Text-fig. 29) is a large specimen of the smooth form, septate to 400 mm in diameter, and retaining a short sector of body chamber. The juvenile suture of FSIT MS6 is partially exposed (Text-fig. 20D). A has a narrow phylloid element preserved; A/U2 is low and broad, with minor incisions as do the other lobes and saddles. That of FSIT RII (Text-fig. 20C) is very deeply incised. E/A is divided into two by a deep adventive lobe, the external element with a very narrow stem and subphylloid folioles. A is broad, with a large, narrow-stemmed median element.

DISCUSSION: Until the recent publication by Amédro and Devalque *in* Robaszynski *et al*. (2014) there was a general assumption that *Coilopoceras* from Western Europe were *C. requienianum*. These authors demonstrated that *Coilopocera*s occurred at three levels in the Uchaux Massive in Vaucluse. *C. requienianum* comes from two levels, associated with *Romaniceras* (*R*.) *deverianum* and at a higher level, associated with *Subprionocyclus bravaisianus*. At a lower level, associated with *Romaniceras* (*R*.) *mexicanum*, they recorded 10 specimens that they referred to as *C.* cf. *springeri*, in the absence of critical details of the suture line. The sutures of the present specimens, although incomplete, show, in FSIT RE II (Text-fig. 20C), deeply incised elements; E/A is divided in two by a deep adventives lobe, and A has a large median element. This pattern is quite distinct from that of *C. requienianum* (Kennedy and Wright 1984, text-fig. 5) where the stem of E/A is broad, there is no deep adventive lobe, and minor frills on E/A are plump rather than subphylloid. In this respect the sutures correspond better with those of *C. springeri* as figured by Cobban and Hook (1980, text-fig. 11a–d).

OCCURRENCE: Middle Turonian, *Prionocyclus hyatti* Zone of New Mexico, north-central and Trans-Pecos Texas in the United States, and northern Mexico. In the Uchaux Massif in Vaucluse*, C*. cf. *springeri* occurs in the *Romaniceras* (*R*.) *mexicanum* Zone, and the species is now recorded from the southern Corbières, in Aude.

Suborder Ancyloceratina Wiedmann, 1966
Superfamily Turrilitoidea Gill, 1871
Family Anisoceratidae Meek, 1876

Genus *Allocrioceras* Spath, 1926b

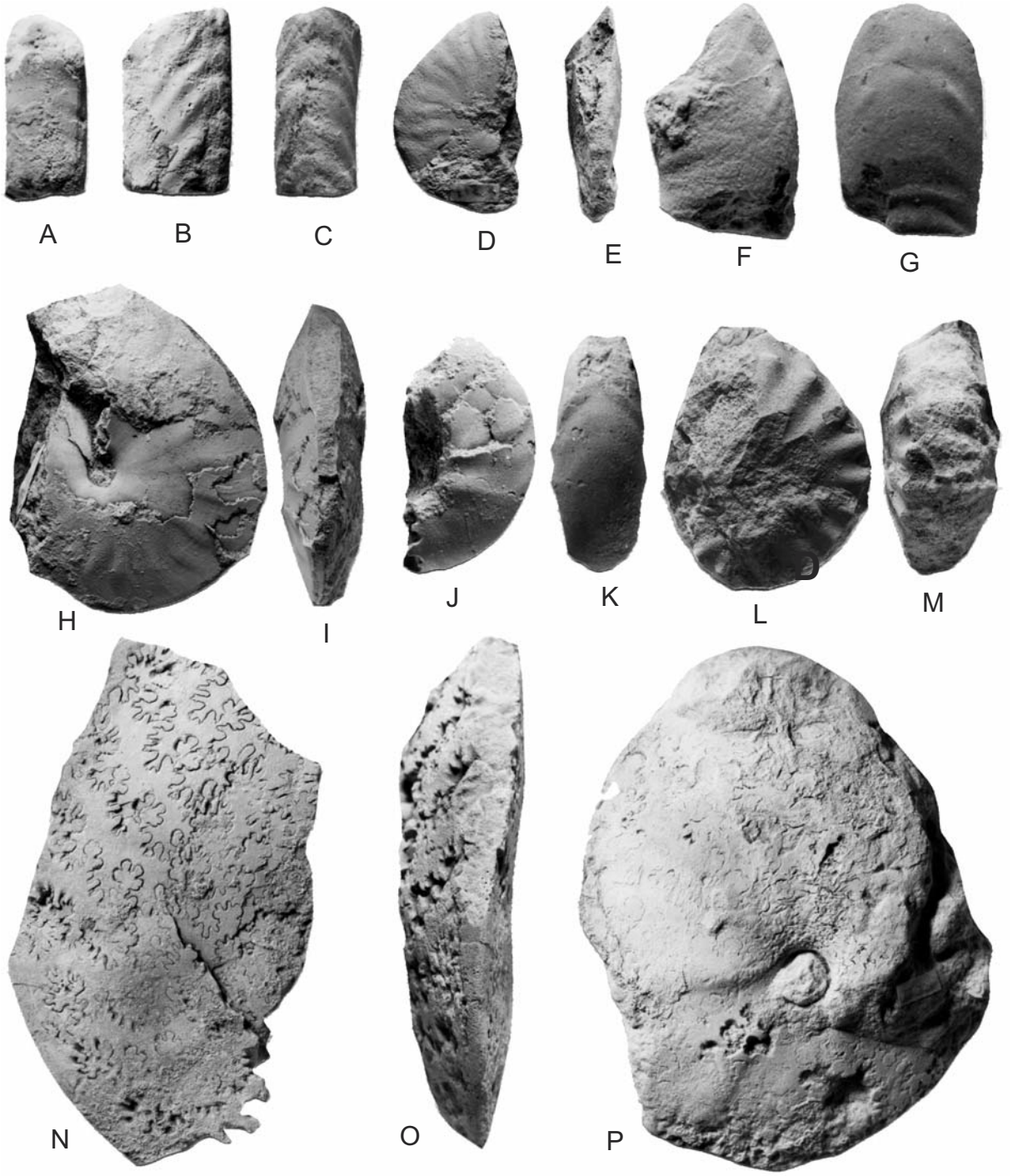
TYPE SPECIES: *Crioceras ellipticum* Woods, 1896 (*non Hamites ellipticus* Mantell, 1822, p. 122, pl. 23, fig. 9), by the original designation of Spath, 1926b, p. 80 = *Hamites angustus* J. de C. Sowerby *in* Dixon 1850, p. 346, pl. 29, fig. 12.

Allocrioceras sp. cf. *angustum* (J. de C. Sowerby, 1850)
(Text-fig. 27Q, R)

1850. *Hamites angustus* J. de C. Sowerby *in* Dixon, p. 346, pl. 29, fig. 12.

1979. *Allocrioceras angustum* (J. de C. Sowerby); Wright, p. 290, pl. 1, figs 9–11 (with synonymy).
1989. *Allocrioceras angustum* (J. de C. Sowerby, 1850); Kaplan, p. 73, pl. 7, figs 1, 3 (with synonymy).

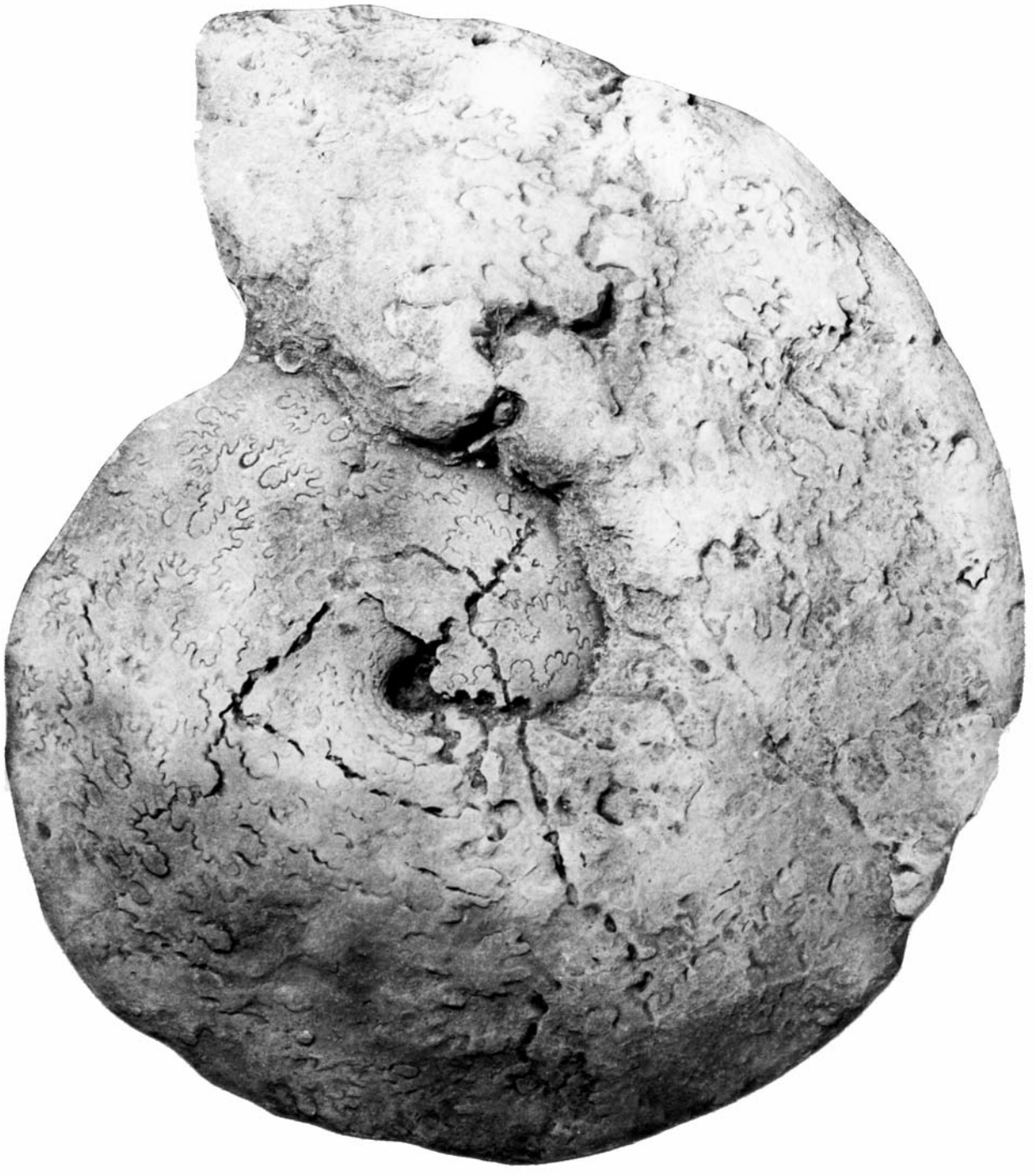
TYPE: The holotype, by monotypy, is the original of J. de C. Sowerby *in* Dixon 1850, p. 350, pl. 29, Fig. 12, from the Chalk of Sussex. The original has not been traced.



Text-fig. 28. **A-C** – *Sciponoceras* sp. from SW Marsa. **D, E, H, I, N-P** – *Coilopoceras springeri* Hyatt, 1903. D, E, MC3, from the Marnes inférieures de Saint-Louis ; H, I, MS6, from N of le Devès (Padern area); N, O, FSIT REII, P, FSIT REIII, from Rennes-les-Bains. **F, G, J, K** – *Romaniceras* sp. juv. F, G, FSIT MSNP5, from NE of Marsa; J, K, FSIT CTP2, from Les Capitaines. **L, M** – *Mammites powelli* Kennedy, Wright and Hancock, 1987, FSIT BS1, from Baillesats. Figures A–C are × 3; figures D–E, H–I, are × 1; figures F, G, J, K, are × 5; L, M, are × 1 ; N–P, are × 1

MATERIAL: FSIT DS2, from Devès (Padern area).

DISCUSSION: The fragment is 25.2 mm long, straight, with a maximum preserved whorl height of 15.2 mm the whorl section oval, with a whorl breadth to height ratio of 0.85. The rib index is five, the ribs near-effaced on the dorsum, strengthening across the dorsolateral margin, straight and prorsiradiate across the flanks, sharp, and narrower than the interspaces. All bear small ventrolateral bullae, linked across the venter by a broad, blunt rib that weakens at mid-venter. Of described species, the fragment most closely resembles *Allocrioceras angustum*, as with fragments figured by Wright (1979, pl. 1, figs 9–11).



Text-fig. 29, *Coilopoceras springeri* Hyatt, 1903. FSIT MB579, from Rennes-les-Bains, reduced × 0.5; the original is 400 mm in diameter

OCCURRENCE: As for material. *Allocrioceras angustum* is recorded from the Upper Turonian *Subprionocyclus neptuni* Zone of southern England, northern France, Germany and Poland. There are also possible records from the Upper Turonian of South Dakota, USA, and the Coniacian of KwaZulu-Natal in South Africa.

Family Nostoceratidae Hyatt, 1894
Genus and subgenus *Eubostrychoceras* Matsumoto, 1967

TYPE SPECIES: *Eubostrychoceras indopacificum* Matsumoto, 1967, p. 333, pl. 18, fig. 1, by original designation by Matsumoto, 1967, p. 332.

Eubostrychoceras (*Eubostrychoceras*) *saxonicum* (Schlüter, 1872)
(Text-fig. 27K, L)

1874. *Turrilites polyplocus* F.A. Roemer; Geinitz, p. 195, pl. 36, figs 1, 2.
1875. *Turrilites saxonicus* Schlüter, p. 30.
1979. *Didymoceras saxonicum* (Schlüter); Wright, p. 296, pl. 2, figs 8–12; pl. 7, fig. 5 (with synonymy).
1988. *Eubostrychoceras saxonicum* (Schlüter, 1875); Kaplan and Schmid, p. 50, pl. 1, figs 1–3; pl. 2, figs 1–6; pl. 3, figs 1–3.
2014. *Nostoceras* (*Eubostrychoceras*) *saxonicum* (Schlüter, 1875); Wilmsen and Nagm, p. 231, text-fig. 15b–d.

TYPE: The lectotype, by the subsequent designation of Kaplan 1988, p. 50, is no. 10101 in the collections of the Senkenberg Naturhistorische Sammlungen, Dresden, Museum für Mineralogie und Geologie, Sektion Paläozoologie, Kreide in Sachsen, the original of *Turrilites undulatus* Mantell of Geinitz, 1840, pl. 13, fig. 1, from Strehlen, Saxony. It was refigured by Wilmsen and Nagm, 2014, text-fig. 15d.

MATERIAL: FSIT MC7, from the Calcaires de Montplaisir.

DESCRIPTION: The specimen is an internal mould of 1.5 whorls of a helix with a maximum preserved diameter of 24 mm and a maximum preserved whorl height of 13 mm. The whorls are in close contact, the upper whorl surface concave, to accommodate the base of the preceding whorl. The outer and lower whorl faces are broadly rounded. Ornament is of crowded single, narrow ribs. They pass straight across the exposed part of the upper whorl face and are feebly convex across the junction of upper and outer whorl faces, the upper and middle parts of the outer whorl face, and feebly concave on the lower part of the outer whorl face and the junction between outer and lower whorl faces. There are periodic widely spaced constrictions that parallel the ribs on the adapertural part of the lower whorl of the fragment.

DISCUSSION: The specimen falls within the range of intraspecific variation shown by topotype material from the Upper Turonian of Dresden-Strehlen (Wilmsen and Nagm 2014, p. 231, text-fig. 15b–d) and that from the Münster Basin in Germany (Kaplan and Schmid 1988, p. 50, pl. 1, figs 1–3; pl. 2, figs 1–6; pl. 3, figs 1–3)

OCCURRENCE: Middle Turonian of the southern Corbières, Aude, Lower Upper Turonian *Subprionocyclus neptuni* Zone fauna of the Chalk Rock in southern England and correlatives in the Pas de Calais and Aube in France, Germany, Poland, the Czech Republic, Kazakhstan and Central Tunisia. Lower Coniacian of Madagascar.

Family Baculitidae Gill, 1871
(= Eubaculitinae Brunnschweiler, 1966, p.24)
Genus *Sciponoceras* Hyatt, 1894
(= *Cyrtochilus* Meek, 1876, p. 392, *non* Jakowlew, 1875, p. 252; *Cyrtochilella* Strand, 1929, p. 8)

TYPE SPECIES: *Hamites baculoides* Mantell, 1822, p. 123, pl. 23, figs 6, 7, by original designation by Hyatt 1894, p. 578.

Sciponoceras sp.
(Text-fig. 28A–C)

MATERIAL: FSIT MSSP/1, from the Padern area.

DESCRIPTION AND DISCUSSION: The specimen is an internal mould of a phragmocone fragment with a maximum length of 11.6 mm, a maximum preserved whorl height of 6.5 mm, and a whorl breadth to height ratio of 0.74. The whorl section is ovoid, the venter more narrowly rounded than the dorsum. The rib index is 3.5. The ribs are weak and concave on the dorsum, strengthen across the dorsolateral margin and are straight and very prorsirdiate on the flanks, across which they strengthen markedly, flexing back across the ventrolateral margin, and crossing the venter in a broad convexity. The specimen is too incomplete for specific identification.

OCCURRENCE: As for material.

Superfamily Scaphitoidea Gill, 1871
Family Scaphitidae Gill, 1871
Genus *Worthoceras* Adkins 1928

TYPE SPECIES: *Macroscaphites platydorsatus* Scott, 1924, p. 18, pls 5, 6, pl. 9, fig. 6, by the original designation by Adkins 1928, p. 218.

Worthoceras cf. *rochatianum* (d'Orbigny, 1850)
(Text-fig. 27I)

Compare:

1850. *Scaphites rochatianus* d'Orbigny, p. 147.
1913. *Macroscaphites rochatianus* (d'Orbigny); Roman and Mazerin, p. 9, pl. 4, figs 1–4.
1965. *Worthoceras rochatianum* (d'Orbigny); Wiedmann, pl. 60, figs 4–6.
2014. *Worthoceras rochatianum* (d'Orbigny); Amédro and Devalque *in* Robaszynski *et al*., p. 163, pl. 39, fig. 13.

TYPE: The holotype, by monotypy, is MNHP d'Orbigny Collection 6131, from Uchaux, Vaucluse. It was figured by Roman and Mazerin 1913, pl. 4, fig. 1.

MATERIAL: FSIT PP 11–13, from the Saint-Louis syncline.

DESCRIPTION: The specimens are tiny limonitic nuclei 7.3–9 mm in diameter. Coiling is very evolute, serpenticone, the umbilicus broad and shallow, comprising 43% approximately of the diameter, the umbilical wall subvertical, the umbilical shoulder broadly rounded. The whorl section is slightly depressed, with feebly convex inner flanks, flattened, convergent outer flanks, broadly rounded ventrolateral shoulders, and a very feebly convex venter. Some of the specimens are smooth; that illustrated (FSIT PP11) has traces of feeble, low prorsirsdiate ribs.

DISCUSSION: The smooth individuals differ in no significant respects from the spire of the holotype. The figured specimen finds a match in the feebly ribbed topotype figured byWiedmann (1965, pl. 60, fig. 5).

OCCURRENCE: Middle Turonian of the southern Corbières, Aude, France. Upper Turonian of Uchaux, Vaucluse, France.

Acknowledgements

We thank David Sansom of the Department of Earth Sciences, Oxford and Christiane Cabaré-Hester of the Department of Geosciences Environnement Toulouse, for their assistance in drafting the figures incorporated in this contribution. We thank Francis Amedro for his critical review of the manuscript.

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Manuscript submitted: 28th April 2015
Revised version accepted: 15th October 2015