AMMONITE FAUNAS, BIOSTRATIGRAPHY AND SEQUENCE STRATIGRAPHY OF THE CONIACIAN-SANTONIAN OF THE CORBIÈRES (NE PYRÉNÉES)

FAUNES D'AMMONITES, BIOSTRATIGRAPHIE ET STRATIGRAPHIE SÉQUENTIELLE DU CONIACIEN-SANTONIEN DES CORBIÈRES (NE DES PYRÉNÉES)

William James KENNEDY, Michel BILOTTE and Patrice MELCHIOR

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Les faunes d'ammonites du Coniacien-Santonien des Corbières sont révisées, et près de 100 espèces et sous-espèces sont décrites. Les 4 zones d'associations classiques du Coniacien de l'Europe occidentale ont été retrouvées, respectivement de la plus ancienne à la plus récente, les zones à *Forresteria* (*Harleites*) *petrocoriensis*, *Peroniceras* (*Peroniceras*) *tridorsatum*, *Gauthiericeras margae* et *Paratexanites serratomarginatus*. La base du Santonien est marquée par un important renouvellement faunique. Une seule zone d'association, à *Placenticeras polyopsis*, est reconnue; elle est divisée en 3 sous-zones, de bas en haut, les sous-zones à *Nowakites carezi*, *Texanites* (*Texanites*) *gallicus* et *Placenticeras paraplanum*, ces espèces ayant des extensions partielles concomittantes. Ni *P. polyopsis*, ni *T.* (*T.*) *gallicus* n'apparaissent dès la base du Santonien, dans les Corbières; cette absence des placenticeratidés comme des texanitidés à la base du Santonien des Corbières pourrait être liée à des conditions écologiques défavorables. Les successions d'ammonites établies sont intégrées aux séquences de dépôt de l'intervalle de temps considéré; les âges absolus qui s' attachent à quelques espèces fournissent la trame d'un premier cadre chronostratigraphique.

William James Kennedy, Geological Collections, University Museum, Parks Road, Oxford, OX1 3PW, U.K.; Michel Bilotte, URA 1405 du CNRS, et Laboratoire de Géologie Sédimentaire et de Paléontologie, Université Paul-Sabatier, Toulouse III, 39, allées Jules-Guesde, F-31062 Toulouse CEDEX; Patrice Melchior, Roquetaillade, F-11300 Limoux. – September 4, 1995.

Mots-clefs : Monographie, Faune ammonite, Biostratigraphie, Coniacien, Santonien, *Ammonoidea*, Stratigraphie séquentielle, Aude, Corbières.

ABSTRACT

The Coniacian-Santonian ammonite faunas of the Corbières are revised, and nearly 100 species/subspecies described. The Coniacian can be subdivided into four assemblage zones, as elsewhere in Western Europe, with successive zones of *Forresteria* (*Harleites*) *petrocoriensis*, *Peroniceras* (*Peroniceras*) *tridorsatum*, *Gauthiericeras margae* and *Paratexanites serratomarginatus*. The base of the Santonian is a level of marked faunal turnover. A single Assemblage Zone of *Placenticeras polyopsis* is recognized, divided into Assemblage Subzones of *Nowakites carezi*, *Texanites* (*Texanites*) *gallicus*, and *Placenticeras paraplanum*. These species have partially overlapping ranges. Neither *P. polyopsis* nor *T.* (*T.*) *gallicus* range to the base of the Santonian in the Corbières; placenticeratids and texanitids are absent from the lowest part of the stage there, presumably as a result of ecological exclusion. The ammonite succession is integrated with the sequence stratigraphy of the interval, and provides a basis for assigning numerical ages to parts of the sequence.

Key words : Monographs, Ammonoids, Biostratigraphy, Coniacian, Santonian, *Ammonoidea*, Sequence stratigraphy, Aude, Corbières.

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INTRODUCTION

The Coniacian and Santonian stages were introduced by Coquand in 1857, and have type areas around Cognac and Saintes respectively in the northern part of the Aquitaine Basin of SW France. Subsequent workers [e.g. Arnaud, 1877, 1883; de Grossouvre, 1901; Séronie-Vivien, 1972 (with extensive bibliography); Kennedy (1984a : Coniacian, 1987 : Santonian); Platel, 1989] have discussed certain inadequacies of the type sections and type areas of the two stages, in particular their unsuitability as boundary stratotypes, and the absence or great rarity of key biostratigraphic markers, notably ammonites.

Already in 1901 de Grossouvre realised this inadequacy and drew attention to the rich ammonite faunas of the Corbières, a region much better suited for the characterization of the Santonian stage. New collections (M. Bilotte & P. Melchior) of more than 600 *in situ* specimens, plus a search through existing collections confirms this view, and shows the Santonian of the region to yield the most diverse fauna yet recognized in Western Europe, while the Coniacian yields four successive zonal assemblages that confirm the succession inferred by Kennedy (1984a, b) elsewhere in France. Revision of these faunas show the Corbières to be a key region for our understanding of Coniacian-Santonian ammonite stratigraphy; this stratigraphy can be integrated with the series of third order sedimentary sequences recently identified by Bilotte (1992, 1993), while certain marker species can be assigned chronostratigraphic ages on the basis of their occurrence in the United States Western Interior, where they are associated with well-dated bentonites (Obradovich, 1993; Gradstein *et al.*, 1994).

1. — REGIONAL GEOLOGY

1.1. PREVIOUS WORK

De Grossouvre (1901) provided a review of early work on the Cretaceous of the Corbières (D'Archiac, 1859; Toucas, 1879; Roussel, 1893; ...), and gave the first coherent synthesis of the stratigraphy and faunas of the region. He particularly drew attention to the significance of two groups : ammonites and rudists (of which the former are revised below), noting that the former showed affinities with those of Aquitaine, Provence, the Austrian Alps, Westphalia and Bohemia, proposing that, should the Coniacian and Santonian be united into a single stage, the term Corbièrien be used.

The next significant contributions on the Coniacian and Santonian of the Corbières came with the work of Sénesse (1937, 1956), who provided meticulous details of faunal occurrences, and Basse (1939) who described ammonites collected by Sénesse, complementing the work of de Grossouvre (1894). This was amplified by Bilotte & Collignon (1983) who documented further additions to the ammonite fauna.

1.2. LITHOSTRATIGRAPHY

Lithostratigraphic units of Coniacian and Santonian age outcrop widely on the southern flank of the Massif de Mouthoumet, notably in the synclines of Rennes-les-Bains and Bugarach-Soulatgé (Fig. 1), where the Calcaires de Montferrand and Marno-calcaires à *Gauthiericeras* are referred to the Coniacian, the Marnes à *Micraster*, Calcaires du Petit Lac, the terrigenous and bioconstructional Montagne des Cornes sequence and their lateral equivalent, the Marnes Bleues de Sougraigne, to the Santonian (Fig. 2). Following the work of Sénesse (1956), we place the Turonian-Coniacian boundary below the Calcaires de Montferrand, within the Grès de la Sals, a variable sequence that overlies the hippuritid limestones of the Turonian and their lateral equivalents.

The Santonian-Campanian boundary cannot be placed with any precision; Upper Santonian marls being succeeded by the unfossiliferous Grès d'Alet (Fig. 2).

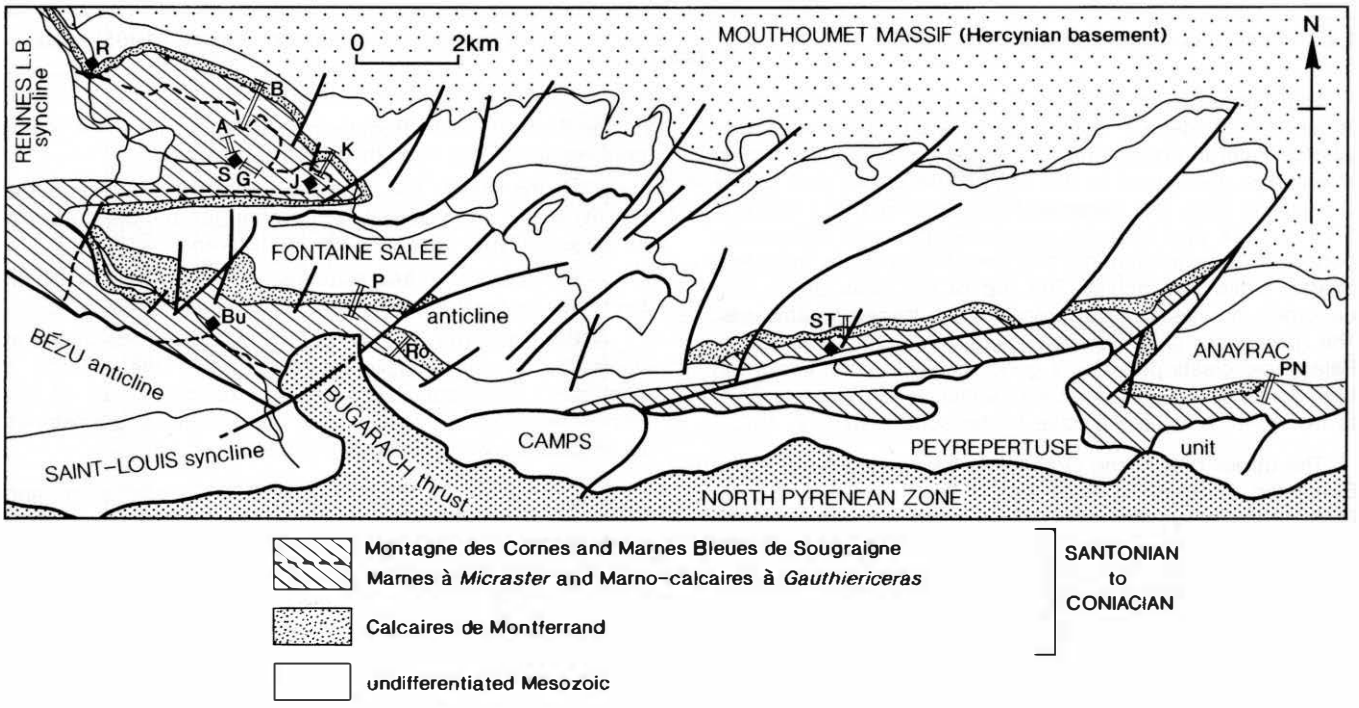

FIGURE 1

Simplified geological map showing the distribution of Coniacian and Santonian units on the southern flank of the Mouthoumet Massif.
A : Chemin des Croutets; B : Ravin de la Coume; Bu : Bugarach; G : left bank of the Sals to the east of Sougraigne; K : Chemin de La Jouane; P : Col du Linas; PN : Peyrefitte; R : Rennes-les Bains; RO : Les Pastressis; S : Sougraigne; ST : Soulatgé.

Carte géologique simplifiée montrant l'extension des unités lithologiques du Coniacien et du Santonien sur le revers méridional du Massif de Mouthoumet.

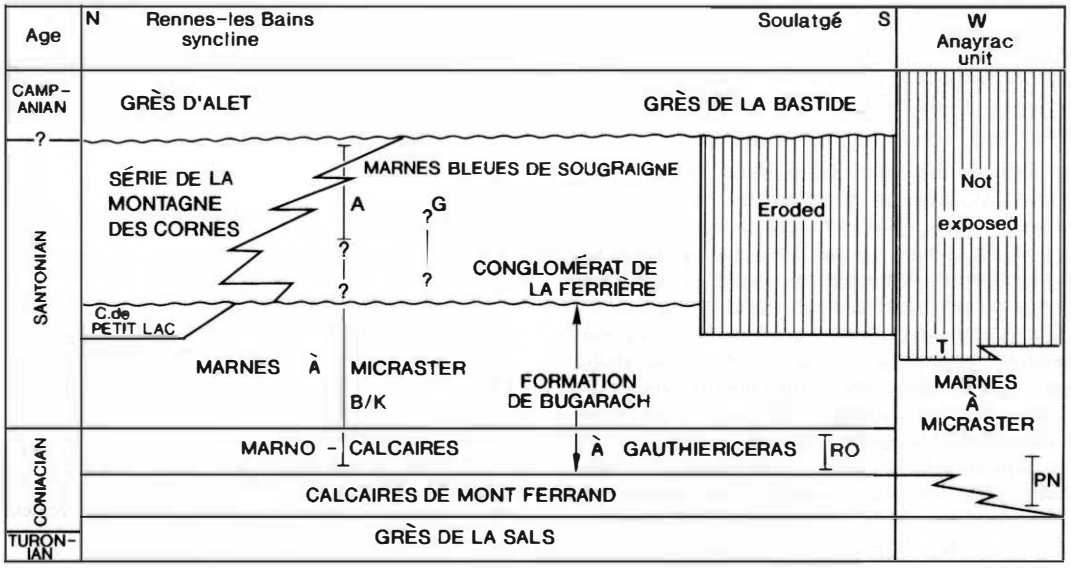

FIGURE 2

Coniacian-Santonian lithological units on the southern flank of the Mouthoumet Massif, showing the principal sections mentioned in the text.
A : Chemin des Croutets; B : Ravin de la Coume; G : left bank of the Sals to the east of Sougraigne; K : Chemin de La Jouane; RO : Les Pastressis; PN : Peyrefitte.

Les unités lithologiques du Coniacien-Santonien sur le revers méridional du Massif de Mouthoumet; relations et position des coupes étudiées (voir texte).

1.2.1. The Grés de la Sals (Bilotte, 1985)

The Grès de la Sals is a predominantly siliciclastic sequence of deltaic origin. Associated carbonates are internal lateral equivalents of hippuritid bioconstructional limestones developed to the south. The upper part of the Grés de la Sals, the Viallasse Member of Bilotte (1985), is 6-15 m thick and includes conglomerates with Palaeozoic pebbles 5-8 cm in diameter that are of local origin, including quartz, lydite and schist. The top of the Grés de la Sals becomes increasingly calcareous when traced southwards. The presence of a laterally persistent conglomerate of Palaeozoic clasts provides a good marker datum, known on both flanks of the Fontaine Salée anticline (Cluse de la Sals, to the north, and La Viallasse to the south) (Bilotte, 1970).

The upper part of the Grés de la Sals was placed in the Coniacian by Sénesse (1956), and in the Turonian by Bilotte (1982, 1985); it actually lies between beds with *Romaniceras* (*Romaniceras*) *deverianum* (d'Orbigny, 1840-1842) and *Coilopoceras requienianum* (d'Orbigny, 1840-1842) of the Turonian below and *Forresteria* (*Harleites*) *petrocoriensis* (Coquand, 1859) of the basal Coniacian above; the Turonian-Coniacian boundary presumably lies in this interval within the Viallasse Member.

1.2.2. The Calcaires de Montferrand (Jacob, 1938)

The boundary between the Grés de la Sals and the succeeding Calcaires de Montferrand is only exposed around Rennes-les-Bains, where it is marked by a transgressive sequence of brown, ochreous fining and thinning upward grainstones to mudstones. In the collines de l'Anayrac, east of Soulatgé (Fig. 1), the Calcaires de Montferrand pass laterally into marls with a Lower Coniacian ammonite fauna of *Forresteria* (*Harleites*) *petrocoriensis*, *Tongoboryceras canali* (de Grossouvre, 1894), and *Eubostrychoceras saxonicum* (Schlüter, 1875) at Peyreffite.

On the north flank of the Rennes-les-Bains syncline, the upper part of the Calcaires de Montferrand have yielded *Forresteria* (*Harleites*) sp., *Paratexanites zeilleri* (de Grossouvre, 1894), and *Scaphites* (*Scaphites*) sp. Around the type locality of Montferrand the uppermost part of the limestones is exposed, dipping to the south, and is the source of the Middle Coniacian ammonites *Peroniceras* (*Peroniceras*) *subtricarinatum* (d'Orbigny, 1850) and *Metatissotia ewaldi* (Von Buch, 1848), described and cited by de Grossouvre (1894, 1901). Between Massac and the Rouffiac road to the east of Soulatgé, the same unit yields *Peroniceras* (*Peroniceras*) *subtricarinatum*, *P.* (*P.*) *westphalicum* (Von Strombeck, 1859), *Metatissotia ewaldi*, *Tissotioides* cf. *haplophyllus* (Redtenbacher, 1873), *Pseudophyllites pyrenaicus* (de Grossouvre, 1894), *Scaphites* (*S.*) *kieslingswaldensis kieslingswaldensis* Langenhan & Gründey, 1891 and *Paratexanites zeilleri* (de Grossouvre, 1894) of the Middle Coniacian, complimenting and confirming the records of Sénesse (1937, 1956).

The ammonites from the Calcaires de Montferrand show that it spans the Lower Coniacian *petrocoriensis* Zone and the Middle Coniacian *tridorsatum* Zone.

1.2.3. The Formation de Bugarach (Bilotte, 1985)

The Formation de Bugarach is divided into three members, totalling 100 m in thickness. These are :

— at the base, the Marno-calcaires à *Gauthiericeras* (24 m) which show lateral facies changes parallel to those in the underlying Calcaires de Montferrand;

— the Marnes à *Micraster* (80 m), a sequence which becomes increasingly silty and micaceous upwards;

— the Calcaires du Petit Lac (6 m), white limestones in decimeter scale beds intercalated within the Marnes à *Micraster*. They occur only in the northern part of the Rennes-les-Bains syncline, and are bioclastic grainstones to floatstones with occasional rudists.

Separation of the Marno-calcaires à *Gauthiericeras* and the Marnes à *Micraster* is more readily made on fossil content than lithology : both yield abundant molluscan and echinoderm faunas. The Marno-calcaires à *Gauthiericeras* have yielded 22 ammonite species from horizons BOa, RO, K1a and P1 (Fig. 3 and 4). Five range up from the Calcaires de Montferrand below and indicate the Middle Coniacian *Peroniceras tridorsatum* Zone, the higher parts yielding elements of the Upper Coniacian *Gauthiericeras margae* and *Paratexanites serratomarginatus* Zones (Fig. 4). The Marnes à *Micraster* have yielded 21 species from horizons K1b-K5; five range from below. The appearance of *Muniericeras* in level K1c marks a significant faunal turnover, with characteristic Santonian elements such as *Pseudoschloenbachia*, *Texasia*, *Placenticeras* and *Texanites* appearing above. The Coniacian-Santonian boundary lies between horizons K1b and K1c (Fig. 3 and 4).

A regional discontinuity, markedly erosive locally, separates the succession described above from a complex of three further sedimentary units.

1.2.4. The Lower Terrigenous complex

This is made up of three principal facies that come to rest successively on the regional discontinuity.

— The conglomerats de la Ferriére (10 m) are folded in conformity with the underlying Turonian-Coniacian strata; they outcrop at the western end of the Fontaine Salée anticline. They are debris flows that incorporate : (a) metre-scale blocks of Calcaires de Montferrand-Marno-calcaires à *Gauthiericeras* that were clearly lithified before transport and have moved only a limited distance; (b) blocks and pebbles of miliolid limestone that show slump features demonstrating them to have been uncemented at the time of movement; (c) quartz pebbles up to 15 cm in diameter. The matrix of the unit is blue marl.

— Sandstones (10-15 m) that underlie much of the village of Rennes-les-Bains. Sandstone beds alternate with blue marls, and have internal structures and grain-size characteristics of delta-front sediments. They are micaceous, and bioturbated. Metre-scale channels with quartz-pebble fills occur (Bilotte, 1989).

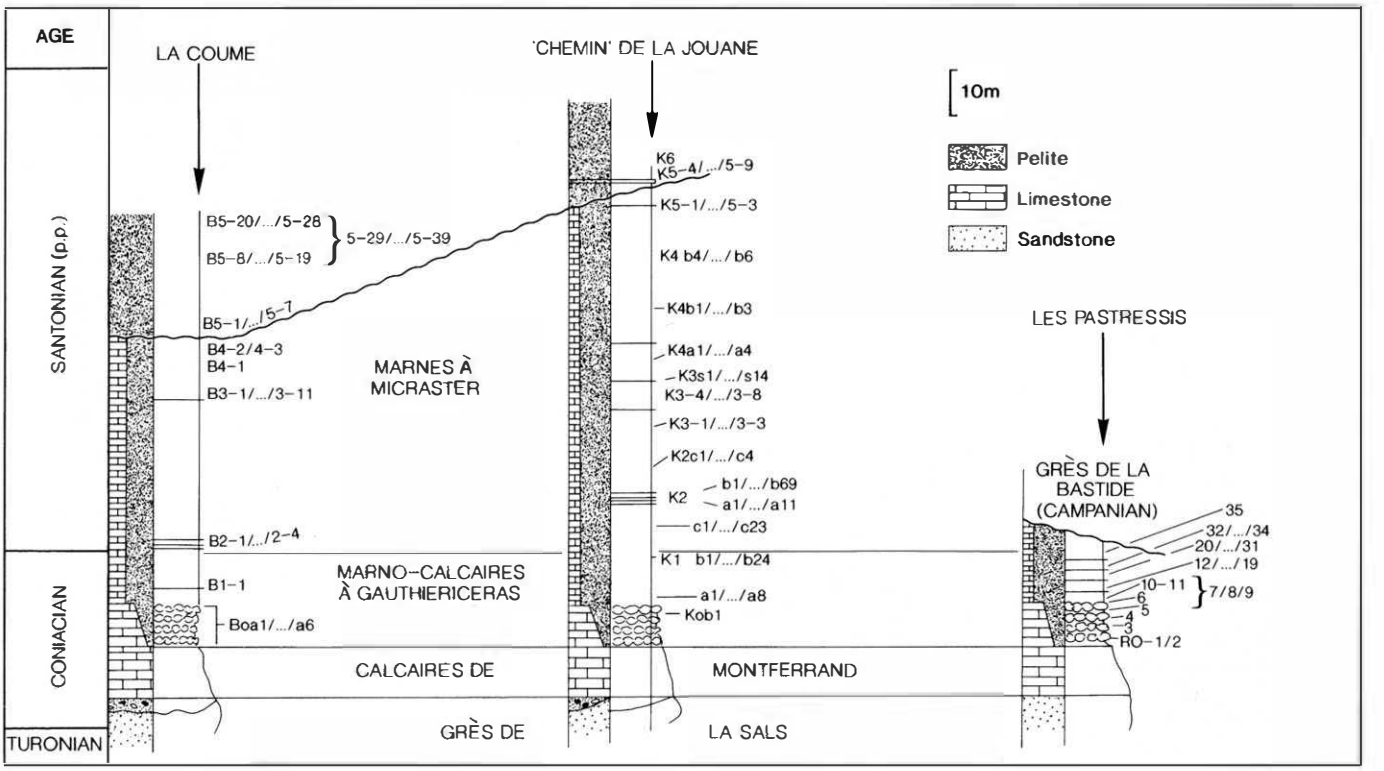

FIGURE 3

Location of fossilliferous horizons in the Coniacian-Santonian units of the Rennes-les-Bains syncline : La Coume, 'Chemin' de La Jouane, and Les Pastressis (Soulatgé).

Position des horizons fossilifères dans les unités lithologiques du Coniacien et du Santonien pro-parte *des synclinaux de Rennes-les-Bains (La Coume, "Chemin" de La Jouane) et de Soulatgé (Les Pastressis).*

No ammonites are known from this sequence, which is restricted to a band that extends from Rennes-les-Bains to La Ferrière. It is overlain by an upper terrigenous sequence which outcrops over the whole of the Rennes-les-Bains syncline, and is made up of the following two units.

1.2.5. The Marnes Bleues de Sougraigne (Toucas, 1879)

The Marnes Bleues de Sougraigne are a 100-250 m thick sequence of micaceous and silty marls with frequent intercalations of fine sandstone. They are well developed in the central part of the Rennes-les-Bains syncline, and correspond to the pro-delta facies in a deltaic complex (Bilotte, 1985).

1.2.6. The Montagne des Cornes sequence (Rolland Du Roouand, 1841)

This succession, some 130 m thick, is developed on the north flank of the Rennes-les-Bains syncline. There are three principal associated facies : (a) bioconstructional rudistid limestones; (b) silty, micaceous blue marls (the Marnes Bleues de Sougraigne); (c) coarse-to-fine micaceous, lignitic sandstones with local conglomeratic intercalations. These facies occur in sequences characteristic of delta-front environments (Allen, 1970; Allen & Mercier, 1987). Facies relationships are particularly well developed in the three highest sequences, each of which begins with bioconstructional rudistid limestones (the levels of the Vieux Cimetière de Sougraigne, and levels C1 and C2 of the Montagne des Cornes sequence : Fig. 5), overlain by the Marnes Bleues pro-delta facies and delta-front sandstones (Bilotte, 1992, 1993).

The Marnes Bleues de Sougraigne and the Montagne des Cornes sequence have long been famous for their rich and diverse fauna, especially outcrops in the environs of Sougraigne (the chemin des Croutets of authors) where the two units interdigitate. 29 ammonite species are known of which 13 occur in the Marnes à *Micraster* below (horizons K5 to A10 in Figure 6). *Placenticeras polyopsis* (Dujardin, 1937) and *Texanites gallicus* (Collignon, 1948) extend almost to the top of the sequence, where they are accompanied by *Placenticeras paraplanum* Wiedmann, 1978, which marks the highest ammonite-bearing Santonian present in the region.

2. — BIO- AND CHRONOSTRATIGRAPHIC RESULTS

New stratigraphic results from the present study may be summarized as follows :

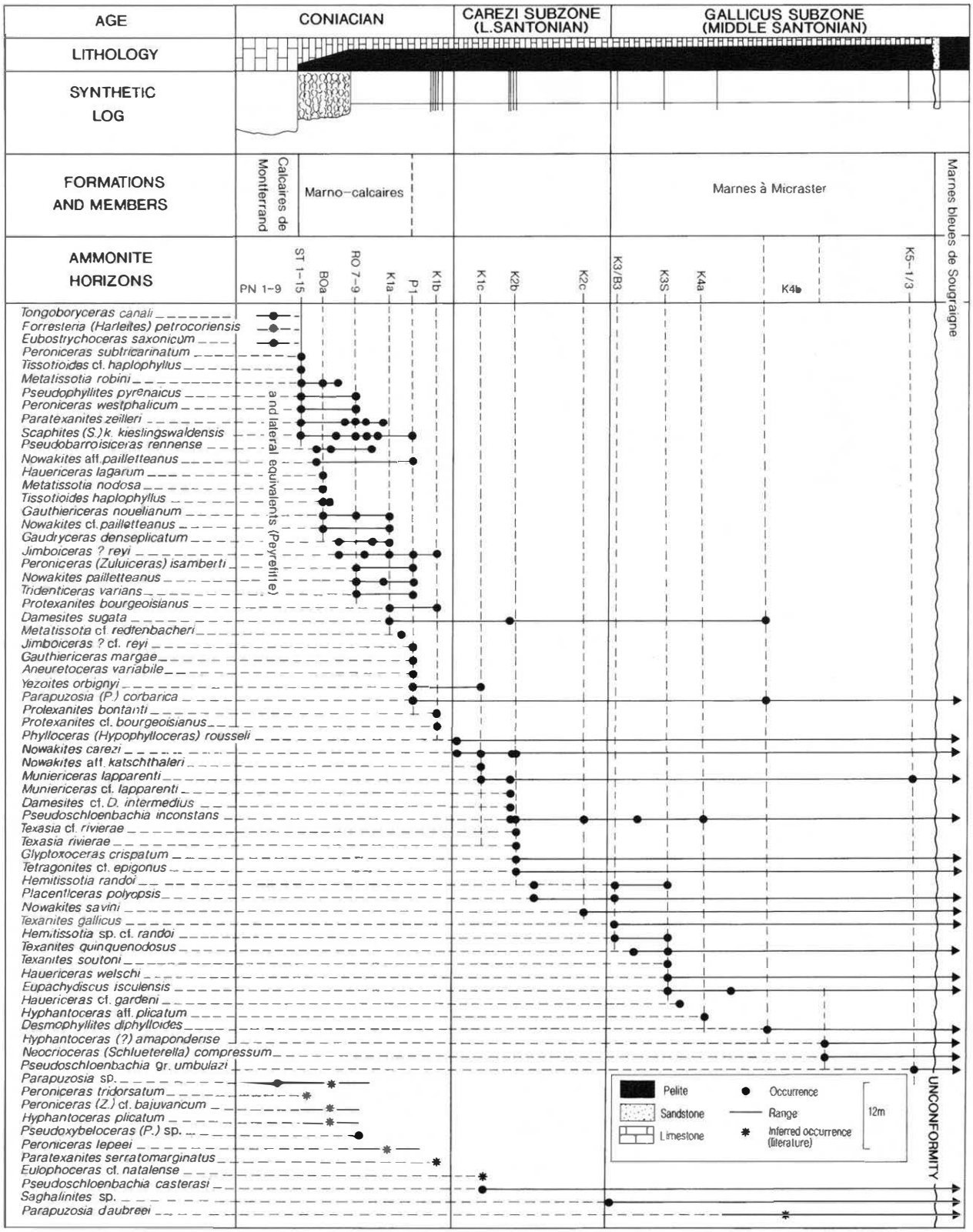

FIGURE 4

Stratigraphy and ammonite distributions in the Coniacian, Lower Santonian and part of the Middle Santonian of the Corbières. B : Ravin de la Coume; K : Chemin de La Jouane; P : Col du Linas; RO : Les Pastressis, Soulatgé; ST : East of Soulatgé between Massac and the Rouffiac road.

Stratigraphie et répartition des ammonites dans le Coniacien et le Santonien inférieur-moyen pro-parte *des Corbières.*

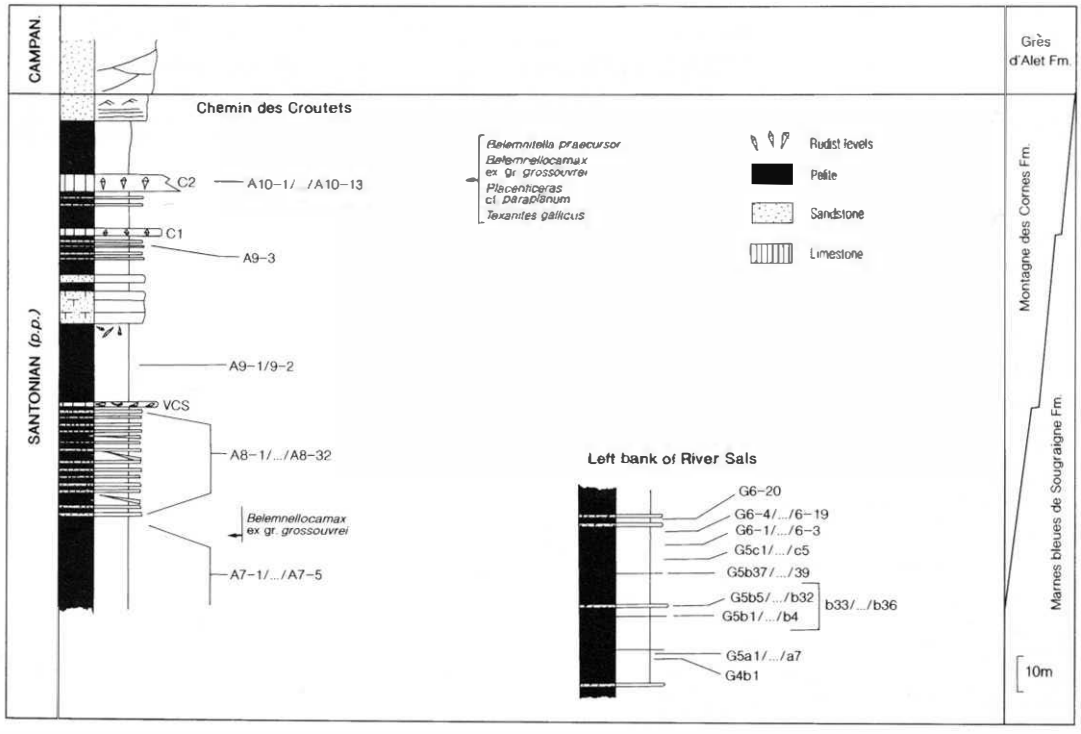

FIGURE 5

Stratigraphic log of the section between Sougraigne and Croutets.
VCS : Vieux Cimetière de Sougraigne; C1 : lower rudist level in the Montagne des Cornes sequence; C2 : Upper rudist level. Horizons yielding ammonites are indicated.

Coupe stratigraphique dans le Santonien, entre Sougraigne et les Croutets, montrant la position des horizons à ammonites.

2.1. **CONIACIAN**

For the Coniacian, the four-fold zonation recognized elsewhere in France (KENNEDY, 1984a) can be applied to the Corbières sequences as follows :

SUBSTAGE	ASSEMBLAGE ZONE
Upper Coniacian	*Paratexanites serratomarginatus* *Gauthiericeras margae*
Middle Coniacian	*Peroniceras* (*Peroniceras*) *tridorsatum*
Lower Coniacian	*Forresteria* (*Harleites*) *petrocoriensis*

Recognition of the Lower Coniacian *petrocoriensis* Zone in the lateral equivalents of the Calcaires de Montferrand confirms the age of this unit, inferred previously on the basis of the presence of a *tridorsatum* Zone fauna at the base of the overlying Marno-calcaires à *Gauthiericeras*, in which *margae* and *serratomarginatus* Zones of the Upper Coniacian can also be identified. For the first time the vertical ranges of a number of taxa (*Pseudophyllites pyrenaicus* (de GROSSOUVRE, 1894); *Paratexanites zeilleri* (de GROSSOUVRE, 1894), etc.) are clarified (Fig. 4). It should be noted that *Paratexanites serratomarginatus* is rare in the Corbières, but co-occurring *Protexanites bontanti* (de GROSSOUVRE, 1894) and *P. bourgeoisianus* (d'ORBIGNY, 1850) are good local markers for the zone, although the latter first occurs in the underlying *margae* Zone (Fig. 4).

2.2. **SANTONIAN**

If the present study confirms the basic ammonite zonation and correlation of the Coniacian stage, the Santonian is more problematic. The Corbières sequence (Fig. 4 and 6) has yielded the most diverse Santonian ammonite fauna known from Europe. Only in Japan, Zululand (South Africa) and Madagascar are more diverse assemblages recorded.

The 1983 Subcommission on Cretaceous Stratigraphy Symposium on Cretaceous Stage Boundaries made the following recommendations with respect to the Coniacian-Santonian boundary (BIRKELUND *et al.*, 1984) : "Boundary level : The consensus at the symposium was that the first appearance of *Texanites* (*Texanites*) and of *Inoceramus* (*Cladoceramus*) *undulatoplicatus* are the two best boundary criteria. These two boundary levels are not directly correlatable, but are probably not widely separated, and may in fact coincide" ....

HANCOCK (1991) provided the most up-to-date review of the position of the base of the Santonian, and of Santonian ammonite zonation, where he referred the whole of the Santonian to a *Placenticeras polyopsis* Zone, following KENNEDY (1987), divided into subzones of *Texanites gallicus* below and *Placenticeras paraplanum* above : "The usual ammonite definition of the base of the Santonian is the appearance of *Texanites s.s.* (BIRKELUND *et al.*, 1984). In the classic regions of north-west Europe this genus is far too rare to be a practical marker. In chalk facies, in particular,

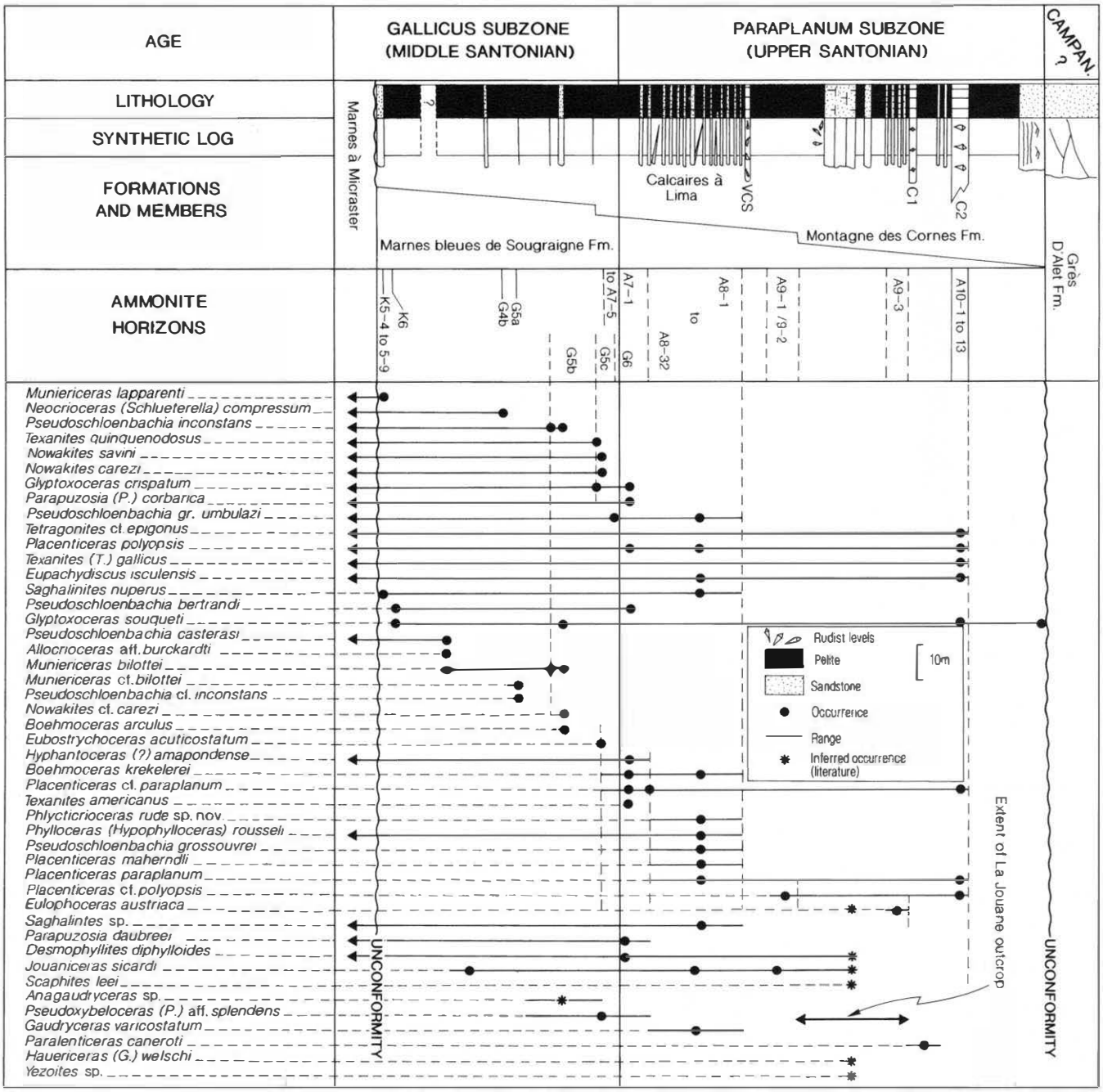

FIGURE 6

Stratigraphy and ammonite distributions in the Middle and Upper Santonian of the Corbières.
A : Chemin de Sougraigne; G : left bank of the Sals, east of Sougraigne; K : Chemin de la Jouane. VCS : Vieux Cimetière de Sougraigne; C1, C2, rudist levels in the Montagne des Cornes Formation.

Stratigraphie et répartition des ammonites dans le Santonien moyen -supérieur des Corbières.

the appearance of *Inoceramus* (*Cladoceramus*) *undulatoplicatus* Roemer is widely used; it is easily identified and is relatively common in North America, Europe and Russia as far east as Kamchatka and Sakhalin. The coincidence of these two appearances has been demonstrated for the Craie de Villedieu in the south-west of the Paris Basin (JARVIS & GALE, 1984) – although the Craie de Villedieu is a relatively condensed succession – and at Olazagutia Quarry, near Alsasua in Navarra, North Spain (*in* BIRKELUND *et al.*, 1984).

The ammonite zonation of the Santonian has been in a mess, and is still not sorted out in Europe.

De GROSSOUVRE (1901) gave two zones, *Placenticeras syrtale* above and *Mortoniceras texanum* (= *Texanites texanus*) below, which have been quoted by almost everyone

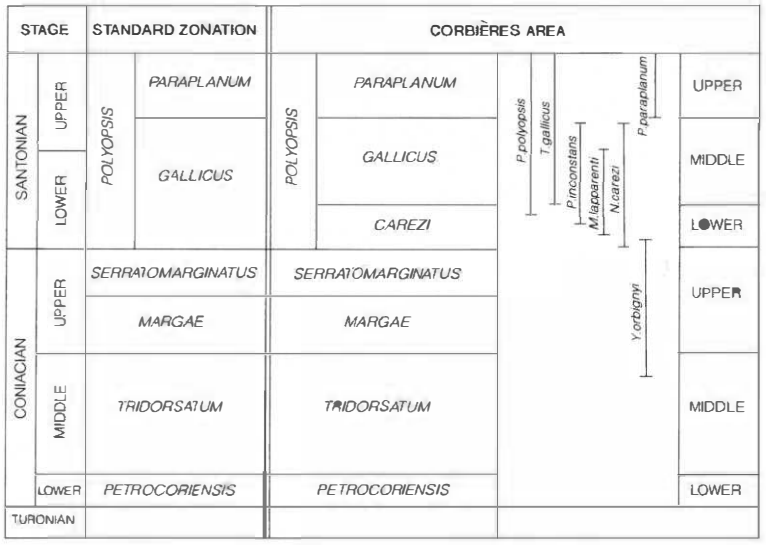

FIGURE 7

Standard Stages, Substages, Zones and Subzones of the Coniacian and Santonian as proposed by HANCOCK (1991) and the divisions recognized in the Corbières. The ranges of certain key ammonite species are indicated.

Corrélations entre la zonation standard du Coniacien-Santonien proposée par HANCOCK (1991) et les subdivisions établies dans les Corbières. L'extension de quelques espèces d'ammonites remarquables est précisée.

ever since. De GROSSOUVRE based his zones on the succession in the Corbières, in the French foothills of the Pyrénées, but he himself was very cautious about his zonation, partly because his *Placenticeras* was "excessivement rare" in the Corbières and partly because he could not demonstrate the same succession anywhere else.

Both of de GROSSOUVRE's index species were originally described from the USA and neither species is known from France and probably do not occur in Europe. *Texanites texanus* (Roemer) *s.s.* is geographically restricted to Texas (KLINGER & KENNEDY, 1980) although closely allied species do occur in Europe and elsewhere. The French forms include, and are probably mainly *Texanites gallicus* COLLIGNON; this has been recorded with *Placenticeras polyopsis* and *Inoceramus* (*Cladoceramus*) in the Reugny Hardgrounds of the Craie de Villedieu (JARVIS & GALE, 1984), but paradoxically, it is still not known if *T. gallicus* ranges to the base of the Santonian in the Corbières.

Placenticeras syrtale MORTON is a Lower Campanian species. The common European Santonian *Placenticeras* is *P. polyopsis* (DUJARDIN) (KENNEDY & WRIGHT, 1983a). This ranges through almost the whole of the Santonian stage as understood in north-west Europe. Most of the specimens from Aquitaine occur in the lower half of the Santonian, *i.e.* in the Subzone of *Texanites gallicus*, but at Rapen, near Recklinghausen in west Germany, it ranges up to levels that contain the top Santonian genus *Marsupites.* Similarly, *P. polyopsis* is found in the 20 m thick "sandkalkband" in Austria with *P. paraplanum* WIEDMANN in an assemblage regarded as top Santonian. Recent collecting near Saintes in Aquitaine shows that there is a top Santonian level with *Marsupites*, *Boehmoceras* and *Placenticeras paraplanum*, the latter being common, but without *P. polyopsis* (Gale, pers. comm.). It therefore seems justified to use an upper Subzone of *Placenticeras paraplanum*".

WIEDMANN (1994) remarked with respect to *Placenticeras polyopsis* that "In Spain, the species seems to flourish in the Lower and Middle Santonian, in France and Germany, however, in the Upper Santonian. In any case, the "Zone of *Placenticeras polyopsis*" as proposed by KENNEDY & WRIGHT (1983a, b) to substitute the previous Upper Santonian Zone of *Placenticeras syrtale* (de GROSSOUVRE, 1901) makes not much sense".

BILOTTE (*in* BILOTTE & COLLIGNON, 1983) proposed a threefold zonal division of the Santonian of the Corbières; a lower Zone of *Texanites gallicus* [*texanus*] only, a middle Zone of *Texanites gallicus* [*texanus*], *Placenticeras polyopsis* [*syrtale*] and *Eupachydiscus isculensis* and an upper Zone of *Placenticeras polyopsis* [*syrtale*] and *Eupachydiscus isculensis*.

Commenting first on HANCOCK's review, we would note only that it is still not demonstrated that the first occurrences of *Texanites gallicus* [= *texanus* of many previous authors (von ROEMER, 1852)] and *Cladoceramus undulatoplicatus* coincide. With respect to the observations of WIEDMANN (1994), *Placenticeras syrtale* of the de GROSSOUVRE and others European authors are all *P. polyopsis*, and the change in zonal name certainly makes sense as it corrects a misidentification.

The data from the Corbières (**Fig.** 4 and 6) show a distinctive Upper Coniacian *serratomarginatus* Zone extending to horizon K1b, with *Protexanites* present. *Texanites gallicus* first appears at horizon K3/B3. The intervening levels K1c, K2a, K2b and K2c span an interval of 28 m, from which we have collected 115 ammonites, 69 of which come from horizon K2b. None of them are texanitids, but species of *Muniericeras*, *Texasia*, *Pseudoschloenbachia* and *Nowakites* make up an assemblage quite distinct from that of horizon K1b below. This faunal turnover marks the base of the Santonian in our view, even in the absence of *Texanites*; that texanitids are altogether absent suggests some ecological exclusion at the critical level, given that the evolutionary origin of *Texanites* lies in a Coniacian texanitid ancestor; horizon K3 has yielded 3 ammonites only; all are *Texanites*. *Placenticeras polyopsis* first occurs a short distance above *Texanites gallicus*, again low in the Santonian, but some way above the base of the stage as defined here.

Placenticeras paraplanum and *Texanites gallicus*, used by HANCOCK (1991) as subzonal indices of a broad *polyopsis* Zone have overlapping ranges in the Corbières, as shown in Figure 6. It is perfectly acceptable to use a *polyopsis*

Assemblage Zone and *gallicus* and *paraplanum* Assemblage Subzones, as long as it is understood that present evidence suggests that *polyopsis* and *gallicus* may not extend to the base of their Zones/Subzones. What zonal scheme can therefore be derived from the Corbiéres sequence? We would suggest a broad *Placenticeras polyopsis* Assemblage Zone, admitting that the index species does not extend to the base of the Santonian in the Corbiéres; placenticeratids are wholly absent from the critical interval (Fig. 4 and 6). Instead, the first appearance of *Nowakites carezi* (de GROSSOUVRE, 1894) marks the base of the Santonian, and the species defines a *carezi* Assemblage Subzone. The first appearance of *Texanites gallicus* marks the base of a *gallicus* Assemblage Subzone, in which *N. carezi* is still present, while the first occurrence of *Placenticeras paraplanum* marks the base of a *paraplanum* Assemblage Subzone in which *T. gallicus* is still present. Figures 4 and 6 summarize range data of taxa that constitute these subzonal assemblages, while Figure 7 compares the zonation proposed for the Corbiéres with that of HANCOCK (1991). The three subzones of the *polyopsis* Assemblage Zone serve to define local Lower, Middle and Upper Santonian substages.

2.3. CHRONOSTRATIGRAPHY

The most reliable numerical ages for the Coniacian-Santonian interval come from high temperature chronometers from bentonites interbedded in the marine sequences of the U.S. Western Interior Seaway and the Gulf Coast, summarized most recently by OBRADOVICH (1993). Some of these ages can be linked to the Corbiéres sequence on the basis of their position relative to ammonite faunas that are common to the two regions.

A *Scaphites preventricosus* Zone bentonite from the Western Interior gave an age of 88.34 ± 0.60 Ma. This zone correlates with the upper part of the *petrocoriensis* Zone and lower part of the *tridorsatum* Zone (KENNEDY & COBBAN, 1991a).

A *Scaphites depressus* Zone bentonite from the Interior gave a date of 86.92 ± 0.39 Ma. It correlates with the Upper Coniacian *serratomarginatus* Zone (KENNEDY & COBBAN, 1991a).

A bentonite from the Santonian of Mississippi, from a level below the *Boehmoceras* fauna described by KENNEDY & COBBAN (1991b) gave an age of 84.09 ± 0.4 Ma. This corresponds to a level some way below horizon G5b in the Marnes Bleues de Sougraigne.

A *Desmoceras bassleri* Zone bentonite from the Western Interior gave an age of 83.91 ± 0.43 Ma. The *bassleri* Zone yields *Scaphites* (*Scaphites*) *leei* REESIDE, 1927 form II of COBBAN (1969), a species common in the *paraplanum* Subzone at the classic La Jouane locality.

The date of the Coniacian/Santonian boundary in the Western Interior is assigned a numerical age of 86.3 ± 0.5 Ma by OBRADOVICH (1993), and 85.8 ± 0.5 Ma by GRADSTEIN *et al.* (1994). We place this boundary between horizons K1b and K1c in the Marnes à *Micraster* of the Corbiéres sequence.

3. — DEPOSITIONAL SEQUENCES

The organization of the Coniacian-Santonian deposits of the Corbiéres into two third-order sequences was established by BILOTTE (1989, 1992, 1993). New sedimentological observations together with a more refined biostratigraphic framework based on the ammonite faunas permits a more precise definition of the two sequence systems tracts (Fig. 8).

3.1. THE BUGARACH SEQUENCE : CONIACIAN-LOWER SANTONIAN

The three systems tracts of the Bugarach sequence are as follows : (a) the lowstand wedge systems tract is a terrigenous unit of regional extent, located at the top of the Grés de la Sals. The lenticular conglomerates with Palaeozoic clasts found north of Rennes-les-Bains may correspond to incised valley fill, marking the earliest stages of sea-level rise; (b) the transgressive systems tract includes the Calcaires de Montferrand (made up of retrogradational parasequence sets), and the Marno-calcaires à *Gauthiericeras*; (c) the highstand systems tract comprise the aggradational and progradational succession of the Marnes à *Micraster* and Calcaires du Petit Lac (early to late HST). This organization complies with the characteristics of a ramp setting sequence (VAN WAGONER *et al.*, 1988).

The apparent discontinuity at the top of the Calcaires de Montferrand consolidated units does not represent the maximum flooding surface (BILOTTE, 1993), corresponding rather to one of the successive flooding surfaces of the transgressive systems tract. The maximum flooding surface is probably located in the interval of faunal horizons K1a-K1b (Fig. 4), characterized by their rich Upper Coniacian ammonite fauna. Such a position is compatible with the position of the maximum flooding surface at Javrezac in Northern Aquitaine, "a locality mentioned by Coquand as a type section for both Coniacian and Santonian stages [where] the boundary between them is easily drawn at a hardground between glauconitic limestones of the Coniacian below and marls of the Santonian above" (KENNEDY, 1984a).

The sequence boundary in the Corbiéres is thus defined by an unconformity.

3.2. THE MONTAGNE DES CORNES SEQUENCE : SANTONIAN *PRO PARTE*

The three systems tracts of the Montagne des Cornes sequence are made up as follows :

— (1) the lowstand systems tract is made up of the following three south-to-north, basinward-to-landward facies : (a) the Conglomerat de La Ferriére, interpreted as canyon fill deposits; (b) deltaic shallow-marine sandstones and siltstones; (c) channel fill deposits, interpreted as incised valley fill;

— (2) the transgressive systems tract has not yet been identified within the Marnes Bleues succession, but may be represented, in part at least, by sandstones overlying the Calcaires du Petit Lac, and those present on the Route de La Jouane;

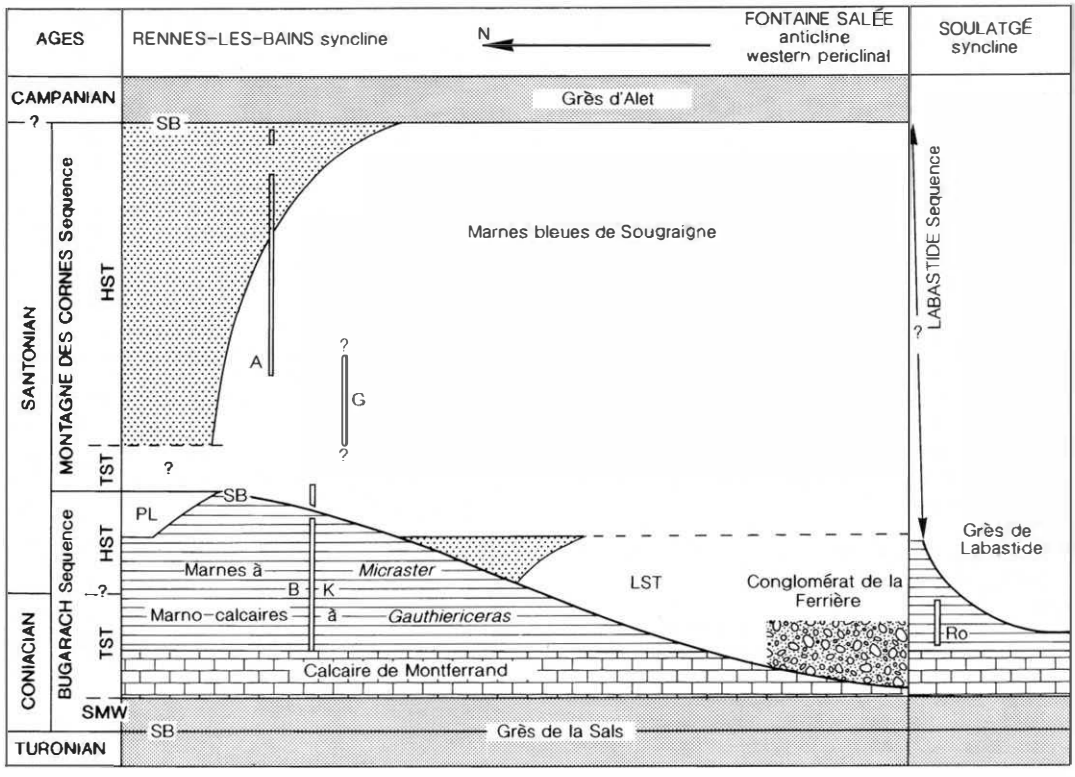

FIGURE 8

Depositional sequences, sedimentary suites and position of sections yielding ammonites in the Coniacian-Santonian of the southern part of the Corbières (not to scale).

A : Chemin des Croutets; B : Ravin de la Coume; G : left bank of the Sals to the east of Sougraigne; K : 'Chemin' de La Jouane; PL : Petit Lac; RO : Les Pastressis. SB : sequence boundary; LST : lowstand systems tract; SMW : shelf margin wedge; TST : transgressive systems tract; HST : highstand systems tract.

Séquences de dépôt, cortéges sédimentaires et situation des gisements d'ammonites du Coniacien-Santonien des Corbières méridionales.

— (3) the highstand systems tract is represented by the Marnes Bleues de Sougraigne and the Montagne des Cornes sequence. The systems tract is characterized by an expansion of the deltaic complex, which is made up of transgressive-progradation sequences with an organization similar to that of fourth order cycles. The organization is best observed in the three major sequences of the upper highstand systems tract : the rudist buildings of the Vieux Cimetière de Sougraigne, and levels C1 and C2 of the Montagne des Cornes sequence mark the transgressive episode, the blue marls and succeeding sandstones record the prograding prodelta and delta-front.

The identification of a terrigenous lowstand systems tract in the Montagne des Cornes sequence leads to some interesting speculations on both sedimentation and structure in the region. Carbonate lowstand wedge systems tracts (Calcaires de Camps-Peyrepertuse) and a transgressive systems tract (Marnes du Pla de Sagnes) have already been linked to the Montagne des Cornes sequence (BILOTTE, 1992, 1993). The marked lithological differences between eastern and western systems tracts is a result of relative displacement of blocks in the Hercynian basement that underlies the Cretaceous sequence. In the Late Santonian, the eastern, uplifted block was fringed by rudistid carbonate buildings on its southern border. In contrast, the foundered western block became the repository of terrigenous sediments derived from the northeast. The genesis of this depositional and structural pattern lay in the development of an east-west left strike-slip fault system through the region (Bilotte, in preparation).

4. — LOCATION OF SECTIONS

Rennes-les-Bains syncline (topographic sheet 2347 Quillan)

A : Chemin de Sougraigne (Lambert coordinates X:601,5; Y:3066,9) aux Croutets (X:600,5; Y:3067,6); horizons A7, A8, A9, A10.

B : Ravin de la Coume, from the Col de la Mouillère (X:602; Y:3068,5) to Sougraigne (X:601,5; Y:3066,8) : horizons BOa, B3.

G : River Sals, left bank, east of Sougraigne (X:601.6; Y:3066,8) : levels G4, G5, G6.

K : Chemin de la Jouane, from the Moulin d'Amont (X:602,9; Y:3067,25) to La Jouane (X:602,7; Y3066.7).

Bugarach – Soulatgé syncline (topographic sheet 2477, Tuchan)

P : Col du Linas (X:604; Y:3064,25).

RO : Les Pastressis (X:604,5; Y:3063,4).

ST : East of Soulatgé, between Massac and the Rouffiac road (X:614,1; Y:3064,4).

PN : Peyrefitte (X622; Y:3062,8).

5. — CONVENTIONS

The following abbreviations are used to indicate the repositories of specimens cited in the text :

BMNH : The Natural History Museum, London.
EMP : École des Mines Collections, now housed in the Université Claude-Bernard, Lyon.
FSL : Faculté des Sciences, Université Claude-Bernard, Lyon.
GPIB : Geologisches und Paläontologisches Institut, Bonn.
MNHP : Muséum National d'Histoire Naturelle, Paris.
OUM : Oxford University Museum.
PM : Patrice Melchior Collection, housed in the UPS Toulouse.
SP : Collections of the Sorbonne, now housed in the Université Pierre et Marie-Curie, Paris.
UMSEN : Université de Montpellier, Sénesse Collection.
UPST : Laboratoire de Géologie sédimentaire et Paléontologie, Université Paul-Sabatier, Toulouse.

The suture terminology used is that of Wedekind (1916) as reviewed by Kullmann & Wiedmann (1970). E = external lobe; L = lateral lobe; U = umbilical lobe; I = internal lobe.

All dimensions are given in millimetres, D = diameter; Wb = whorl breadth; Wh = whorl height; U = umbilicus. Figures in parentheses are dimensions as a percentage of diameter. c and ic refer to costal and intercostal dimensions. The term "rib index", as applied to heteromorphs, is the number of ribs in a distance equal to the whorl height at the mid-point of interval counted.

6. — SYSTEMATIC PALAEONTOLOGY (W.J. Kennedy)

Order Ammonoidea Zittel, 1884
Suborder Phylloceratina Arkell, 1950
Superfamily Phylloceratacea Zittel, 1884
Family Phylloceratidae Zittel, 1884
Subfamily Phylloceratinae Zittel, 1884
(= Phyllopachyceratinae Collignon, 1937)
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*) *rousseli*
(de Grossouvre, 1894)
Pl. 1, fig. 3-5, 9, 10, 18, 19

1894. *Schlüteria rousseli* de Grossouvre (p. 217, pl. 24, fig. 2).
1925. *Ph. Rousseli* de Grossouvre; Diener (p. 43).
1939. *Phylloceras Rousseli* de Gross.; Basse (p. 43, pl. 3, fig. 1, 2).
1956. (?) *Hyporbulites Rousseli* de Grossouvre (A); Collignon (p. 30).

Types : Lectotype, here designated, is MNHP R409, the original of de Grossouvre, 1894 (pl. 24, fig. 2) from the 'Calcaires marneux jaunes à *Lima marticensis*, situés immédiatement au-dessus des marnes bleues qui se trouvent au bas du chemin de Sougraigne aux Croutets (Aude)'. A paralectotype mentioned by de Grossouvre (1894, p. 218) has not been traced.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
Basse 1939 (pl. 3, fig. 2)	13.9 (100)	5.0 (36.0)	8.0 (57.6)	0.63	1.1 (8.0)
Lectotype, MNHP R409	61.0 (100)	23.1 (37.9)	32.5 (53.3)	0.71	8.1 (13.3)

Description : *Phylloceras* (*Hypophylloceras*) from the Santonian of the Corbières occur as pyritic nuclei up to 21.5 mm diameter, and limestone moulds with recrystallized shell 33-60 mm diameter. Nuclei (Pl. 1, fig. 3-5) are very involute, the umbilicus small (8 % of diameter), with a flattened, outward-inclined umbilical wall, producing a conical circumbilical pit. The umbilical shoulder is narrowly rounded, the whorl section compressed, with whorl breadth to height ratio 0.63, the flanks flattened and subparallel, and the ventrolateral shoulders broadly rounded. Ornament is of very fine, scarcely visible radial lirae. The lectotype (Pl. 1, fig. 18, 19) is 61 mm in diameter and slightly distorted, so that the relative proportions given above are approximate only. The specimen retains recrystallized shell, and the position of the end of the phragmocone cannot be determined. Coiling is very involute, the umbilicus comprising 13 % of the diameter, moderately deep, with a flattened, outward-inclined wall. The umbilical shoulder is narrowly rounded, the whorl section compressed, with whorl breadth-to-height ratio 0.71, flattened convergent inner flanks, rounded outer flanks and broadly rounded ventrolateral shoulders and venter. Ornament is very weak on the inner flanks, but strengthens at mid-flank into dense, fine, feebly convex, slightly prorsiradiate lirae that sweep back and are rursiradiate on the outermost flank where they strengthen and pass straight across the venter.

Discussion : *Phylloceras* (*Hypophylloceras*) is represented by limited numbers of specimens in the post-Cenomanian of Europe. *Phylloceras* (*Hypophylloceras*) *bizonotum* (Fritsch, 1872 : p. 40, pl. 14, fig. 7) from the Upper Turonian of the Czech Republic is known from tiny pyritic nuclei only; the original figure suggests a more compressed, higher whorl section with slightly flexuous lirae that are concave rather than convex on the outer flank. Specimens from the Coniacian of Madagascar referred to *bizonotum* by Collignon (1956 : p. 17, pl. 1, fig. 2, 3) overlap in size with the present material and are described as having radial, feebly falcoid ornament, projected weakly forwards on the periphery.

Occurrence : Santonian. In the Corbières *P.* (*H.*) *rousseli* ranges from *carezi* to *paraplanum* Subzones.

Suborder Lytoceratina Hyatt, 1889
Superfamily Tetragonitaceae Hyatt, 1900
Family Tetragonitidae Hyatt, 1900
Genus *Tetragonites* Kossmat, 1895
(= *Epigoniceras* Spath, 1925a (p. 29);
Carinites Wiedmann, 1973 (p. 609))

Type species : *Ammonites timotheanus* Pictet, 1847 (p. 295, pl. 2, fig. 6; pl. 3, fig. 1, 2, by original designation by Kossmat, 1895, p. 131(35)).

Tetragonites epigonus Kossmat, 1895
Pl. 1, fig. 6-8, 11-13; Pl. 2, fig. 5, 6; Pl. 3, fig. 13, 14; Fig. 9

1984. *Gaudryceras Rouvillei* de Grossouvre (p. 228 (*pars*), pl. 37, fig. 10 only).
1895. *Lytoceras* (*Tetragonites*) *epigonus* Kossmat (p. 135(39), pl. 17(3), fig. 4, 5, 10).
1939. *Lytoceras* (*Tetragonites*) *rouvillei* de Gross.; Basse (p. 45, pl. 3, fig. 8).
1939. *Lytoceras* (*Tetragonites*) aff. *epigonum* Kossmat; Basse, (p. 45 (*pars*)).

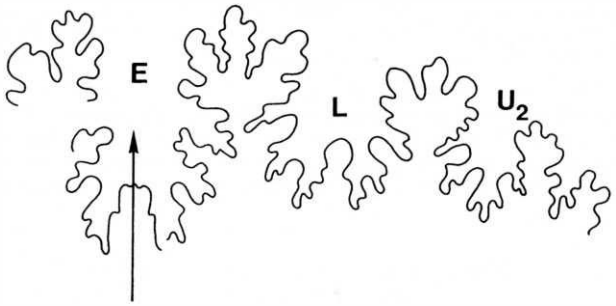

FIGURE 9

Tetragonites epigonus KOSSMAT, 1895.
External suture of UM SEN 035, from the pyritic Upper Santonian *paraplanum* Subzone fauna of La Jouane. Bar scale is 10 mm.

1977. *Tetragonites* cf. *epigonus* KOSSMAT, 1895; KENNEDY & KLINGER (p. 165, fig. 73e-g, 9a-c (with full synonymy)).
1983. *Tetragonites rouvillei* (de GROSSOUVRE); COLLIGNON (p. 186).

Type : Lectotype, designated by KENNEDY & 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.

Discussion : Juvenile *Tetragonites epigonus* (Pl. 1, fig. 6-8, 11-13) are the commonest ammonite in the pyritic faunas of the Marnes Bleues de Sougraigne, and differ in no significant respects from the smaller paralectotype (KOSSMAT, 1895 : pl. 17, fig. 5). Like that specimen, the only ornament on the surface of the shell is growth lines to diameters of 20 mm; internal moulds are smooth. Larger, crushed specimens, best referred to as *T.* cf. *epigonus* that lack constrictions extend to 50 mm diameter (Pl. 3, fig. 13, 14). Much larger is UMSEN 017 (Pl. 2, fig. 5, 6), with well-developed prorsiradiate constrictions, as in the lectotype.

BASSE (1939 : p. 45) though the holotype of *Desmoceras pyrenaicum* de GROSSOUVRE, 1894 (pl. 25, fig. 2; see Pl. 1, fig. 15-17) belonged to the present species, but it is here referred to *Pseudophyllites*. The small tetragonitids referred to as *Tetragonites rouvillei* by previous authors are juvenile *T. epigonus*, although the holotype of *rouvillei* (de GROSSOUVRE, 1894 : pl. 37, fig. 7) is a gaudryceratid.

Occurrence : Turonian-Campanian, with records from Antarctica, Angola, Zululand and Pondoland (South Africa), Madagascar, Japan, South India, British Columbia, South Patagonia, and North Africa. Santonian of the Corbières where the species ranges from *carezi* to *paraplanum* Subzones

Genus *Saghalinites* WRIGHT & MATSUMOTO, 1954

Type species : *Ammonites Cala* FORBES, 1846 (p. 104, pl. 8, fig. 4) by original designation by WRIGHT & MATSUMOTO, 1954 (p. 110).

Saghalinites nuperus (VAN HOEPEN, 1921)
Pl. 3, fig. 3, 4, 10, 11

1921. *Tetragonites nuperus* VAN HOEPEN, p. 13 (Pl. 3, fig. 3, 4; Fig. 8).
1977. *Saghalinites nuperus* (VAN HOEPEN, 1921); KENNEDY & KLINGER (p. 177, fig. 16a-e, 17a-b, 18 (with full synonymy)).

Type : Holotype by original designation is no. 532 in the collections of the Transvaal Museum, South Africa, the original of VAN HOEPEN, 1921 (Pl. 3, fig. 3, 4) (refigured by KENNEDY & KLINGER, 1977 : text-fig. 16a-c), from the Santonian-Campanian Umzamba Formation of Umzamba, Pondoland, South Africa.

Discussion : PM A8-4, 37 mm in diameter, and PM K5-9, 53.5 mm in diameter, are crushed *Saghalinites* with distant, strongly prorsiradiate constrictions, straight on the flanks, flexed back and convex across the ventrolateral shoulder and near-transverse on the venter. They closely match (preservation apart) the well-preserved South African and Madagascan material referred to the species.

Occurrence : Santonian (and possibly Lower Campanian), Zululand and Pondoland (South Africa), Madagascar, Japan. Santonian *gallicus* and *paraplanum* Subzones in the Corbières.

Saghalinites sp.
Pl. 1, fig. 14; Pl. 3, fig. 7-9

1981. *Tetragonites* (*Epigoniceras*) n. sp. [aff. *T. epigonum* KOSSM., 1895]; SZÁSZ (p. 99, pl. 1, fig. 10).
1983. *Hauericeras* aff. *welschi* de GROSSOUVRE; COLLIGNON (p. 192).

Discussion : Specimens range from 20-80 mm diameter (Pl. 1, fig. 14; pl. 3, fig. 9). An uncrushed individual is 56 mm diameter (Pl. 3, fig. 7, 8). Coiling is evolute, the whorls expanding slowly, the umbilicus shallow, the umbilical wall low, flattened, the umbilical shoulder narrowly rounded. The flanks are flattened and subparallel, the ventrolateral shoulders broadly rounded, the venter very feebly convex. Composite and internal moulds are smooth, but for delicate spiral ridges on the ventrolateral and ventral regions, and a prorsiradiate terminal constriction in one specimen. The coiling of these specimens suggests *Saghalinites*, absence of constrictions separating the material from other described species.

Occurrence : Santonian *gallicus* and *paraplanum* Subzones in the Corbières. The same species may also occur in the Coniacian of Romania.

Genus *Pseudophyllites* KOSSMAT, 1895 (p. 137 (41))

Type species : *Ammonites Indra* FORBES, 1846 (p. 105, pl. 11, fig. 7) by original designation by KOSSMAT, 1895 (p. 137(41)).

Pseudophyllites pyrenaicus (de GROSSOUVRE, 1894)
Pl. 1, fig. 1, 2, 15-17; Pl. 3, fig. 1, 2

1894. *Desmoceras pyrenaicum* de GROSSOUVRE (p. 168 (*pars*), pl. 25, fig. 2 only, *non* pl. 37, fig. 9 : *non* text-fig. 9 (= *Desmophyllites diphylloides*)).
1907. *Desmoceras pyrenaicum* de GROSSOUVRE; PERVINQUIÈRE (p. 49, 140, 142, 421).
1925. *Latidorsella pyrenaica* de GROSSOUVRE; DIENER (p. 126).
1961. *Desmophyllites pyrenaicus* de GROSSOUVRE; COLLIGNON (p. 93).

Type : Holotype by original designation is an unregistered specimen in the Sorbonne Collections (*ex* TOUCAS Collection), the original of de GROSSOUVRE, 1894 (p. 168 (*pars*), pl. 25, fig. 2) (Pl. 1, fig. 15-17), from the 'Marnes Bleues situées au-dessous du banc à *Lima marticensis*, sur le chemin de Sougraignes aux Croutets (Aude)'.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP, Pl. 1, fig. 1, 2	57.0 (100)	27.9 (48.9)	28.7 (50.4)	0.97	9.0 (15.8)
Holotype	73.2 (100)	36.5 (49.9)	37.9 (51.8)	0.96	12.0 (16.4)

Description : Specimens range from 40-93 mm diameter. Coiling is moderately involute, the umbilicus small (around 16 % of the diameter), very deep, with a flattened, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is slightly compressed, with the greatest breadth low on the flanks, the inner flanks feebly convex, the outer flanks flattened and conver-

gent, the ventrolateral shoulders broadly rounded and the venter broad and only very feebly convex. Ornament is limited to weak striae, feebly prorsiradiate and straight on the inner flanks and near-transverse on the venter. There are feeble incipient constrictions in the holotype, parallel to the growth lines and conspicuous only across the umbilical shoulder and on the inner flank. Sutures poorly and incompletely exposed, but with complex and deeply incised elements. Septal lobe poorly exposed on PM Re01, small occupying 40 % of the whorl height.

Discussion : *'Desmoceras' pyrenaicum* has been a neglected species, generally referred to *Desmoceras* or *Desmophyllites*. The whorl proportions, suture and ornament all indicate it to be a *Pseudophyllites*, and the oldest known representative of the genus. It is most closely allied to *P. teres* (Van Hoepen, 1920 : p. 144, pl. 25, fig. 1, 2), which has a larger umbilicus with a subvertical rather than outward-inclined wall, much more strongly prorsiradiate growth lines and no inner-flank constrictions.

Occurrence : Middle Coniacian *tridorsatum* Zone in the Corbières.

Family Gaudryceratidae Spath, 1927
Genus and subgenus *Gaudryceras* de Grossouvre, 1894
(= *Epigaudryceras* Shimizu, 1934 (p. 67); *Pseudogaudryceras* Shimizu, 1934 (p. 67); *Hemigaudryceras* Shimizu, 1934 (p. 67); *Neogaudryceras* Shimizu, 1935 (p. 164))

Type species : *Ammonites mitis* Hauer, 1866 (p. 305, pl. 2, fig. 3, 4) by the subsequent designation of Boule *et al.*, 1906 (p. 183(11)).

Gaudryceras mite (Hauer, 1866)
Pl. 1, fig. 20, 21

1866. *Ammonites mitis* Hauer (p. 305, pl. 2, fig. 3, 4).
1894. *Gaudryceras mite* Hauer; de Grossouvre (p. 227, pl. 26, fig. 4; pl. 39).
1979. *Gaudryceras mite* (Hauer); Kennedy & Summesberger (p. 74, pl. 1, fig. 1; pl. 2, fig. 1, 2; text-fig. 1).
non 1983. *Gaudryceras mite* (Von Hauer); Collignon (p. 186, pl. 1, fig. 2).

Type : Holotype, by monotypy, is no. 1866/01/3 in the collections of the Geologische Bundesanstalt, Wien, the original of Hauer, 1866 (p. 305, pl. 2, fig. 3, 4) from the Coniacian Gosau Beds at Strobl, near Isch, Austria.

Description : We have three specimens, UPST S7, a crushed juvenile 47 mm in diameter, MNHP R655, the original of de Grossouvre 1894 (pl. 26, fig. 4) a well-preserved juvenile 77 mm in diameter (Pl. 1, fig. 20, 21), and no 14 256 in the collections of the Département des Sciences de la Terre, Lyon, a large distorted individual 260 mm in diameter from 'Bois du Colombier'.

De Grossouvre's specimen is almost entirely septate and crushed, the shell partially exfoliated. Constrictions are poorly defined, but ornament well preserved. Lirae arise at the umbilical seam, branching and splitting at the umbilical shoulder and on the flanks. The lirae are markedly prorsiradiate on the inner flank, convex at mid-flank and concave on the outer flank, crossing the venter in a marked convexity.

Discussion : See Kennedy & Summesberger (1979) for a revision of this species, including the type material. We have been unable to trace the second specimen figured by de Grossouvre as his pl. 39, a near-adult individual with a diameter of just over 180 mm, in the Peron Collection, from the 'Marnes bleues à *Mortoniceras texanum*, sur le chemin de Sougraignes aux Croutets (Aude)'. Collignon (1983 : p. 286, pl. 1, fig. 2) referred an individual 86 mm in diameter to this species, noting that it lacked ornament (see Pl. 2, fig. 10, 11). Replaced shell is, in fact, preserved in places, and bears very delicate lirae, visible under magnification, and much finer than those of *G. mite*. The specimen is an *Anagaudryceras*.

Occurrence : *Gaudryceras mite* ranges from Turonian to Maastrichtian, and there are records from Austria, the Carpathians, northern Spain, ? North Africa, Angola, Zululand (South Africa), Madagascar, South India, Japan and the sub-Antarctic Islands. In the Corbières the species is imprecisely located within the Santonian.

Gaudryceras varicostatum Van Hoepen, 1921
Pl. 2, fig. 4, 7, 8

1921. *Gaudryceras varicostatum* Van Hoepen (p. 7, pl. 2, fig. 10-12; text-fig. 3, 4).
1979. *Gaudryceras varicostatum* Van Hoepen; Kennedy & Klinger (p. 133, pl. 3, fig. 1-3; pl. 4; pl. 7, fig. 2, pl. 14, fig. 11; text-fig. 1 (with full synonymy)).
1983. *Anagaudryceras varicostatum* (Van Hoepen); Collignon (p. 185, pl. 1, fig. 1).

Type : Holotype, by monotypy, is no. 58 in the collections of the Transvaal Museum, the original of Van Hoepen, 1921 (pl. 2, fig. 10-12), from the Umzamba Formation of Pondoland, South Africa.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
UPST S19	65.8 (100)	21.8 (33.1)	24.2 (36.8)	0.9	26.4 (40.1)

Discussion : See Kennedy & Klinger (1977) for a revision of this species. The specimen from the Corbières is a corroded internal mould with traces of recrystallized shell, ornament being preserved only on small areas of the inner whorls and on the umbilical wall of the outer whorl.

Occurrence : Middle to Upper Santonian *gallicus* to *paraplanum* Subzones in the Corbières. Elsewhere the species is known from the Coniacian of Zululand, Upper Santonian or Lower Campanian of Pondoland, Santonian of Madagascar and (?) Campanian of New Zealand.

Gaudryceras denseplicatum (Jimbo, 1894)
Pl. 2, fig. 1-3; Pl. 3, fig. 15, 16; Pl. 4, fig. 12, 13

1894. *Lytoceras denseplicatum* Jimbo (p. 182, pl. 23, fig. 1).
1979. *Gaudryceras densplicatum* (Jimbo); Kennedy & Klinger (p. 140, pl. 5, fig. 1, 2; pl. 6, fig. 2; pl. 7, fig. 1 (with full synonymy)).
1982. *Gaudryceras* ex gr. *denseplicatum* Yabe, 1903; Immel *et al.* (p. 9, pl. 1, fig. 5).

Discussion : Specimens are all crushed, and up to 60 mm in diameter. The best-preserved (Pl. 4, fig. 12, 13) has six well-preserved, slightly prorsiradiate flexuous collar-ribs on the last half whorl, with relatively coarse, parallel lirae between.

Occurrence : Coniacian *tridorsatum* to *serratomarginatus* Zones in the Corbières. Elsewhere, the species ranges from Coniacian to Campanian in Zululand (South Africa), the Coniacian of Madagascar, Turonian to Coniacian of Japan, Coniacian of northern Spain and Santonian of Austria.

Genus *Anagaudryceras* Shimizu, 1934
(= *Paragaudryceras* Shimizu, 1934 (p. 67); *Murphyella* Matsumoto, 1972 (p. 208))

Type species : *Ammonites sacya* Forbes, 1846 (p. 113, pl. 14, fig. 10, by original designation by Shimizu, 1934, (p. 67)).

Anagaudryceras sp.
Pl. 2, fig. 10, 11

1983. *Gaudryceras mite* (Von Hauer); Collignon (p. 186, pl. 1, fig. 2).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
UPST BO 01	85.0 (100)	31.7 (37.3)	37.0 (43.5)	0.86	22.7 (26.7)

Discussion : Collignon (1983) referred this specimen to *Gaudryceras mite*, taking it to be an internal mould. Traces of recrystallized shell survive in places, and have an ornament of very delicate lirae, invisible to the naked eye, showing the specimen to be an *Anagaudryceras*. It most closely resembles *A. politissimum* (Kossmat, 1895) (see revision in Matsumoto *et al.*, 1985 (p. 23, pl. 3, fig. 1-6; pl. 5, fig. 5-8)) but seems to have a smaller umbilicus.

Occurrence : Santonian *gallicus* Subzone in the Corbières.

Order Ammonitina Hyatt, 1889
Superfamily Desmoceratacea Zittel, 1895
Family Desmoceratidae Zittel, 1895
Subfamily Puzosiinae Spath, 1922
Genus and Subgenus *Parapuzosia* Nowak, 1913

Type species : *Sonneratia daubréei* de Grossouvre, 1894 (p. 154, pl. 28, by original designation by Nowak, 1913 (p. 350)).

Parapuzosia (*Parapuzosia*) *daubreei* (de Grossouvre, 1894)
Fig. 10, 11

1894. *Sonneratia Daubréei* de Grossouvre (p. 154, pl. 28).
1906. *Sonneratia Daubréei* de Grossouvre; Müller & Wollemann (p. 8, pl. 5).
1913. *Parapuzosia Daubréei* de Grossouvre; Nowak (p. 363, pl. 43, fig. 32; pl. 44, fig. 40).
1921b. *Parapuzosia corbarica* (de Grossouvre); Spath (p. 225).
1922. *Parapuzosia daubréei* (de Grossouvre); Spath (p. 126).
1925. *Parapuzosia daubréei* de Grossouvre; Diener (p. 129).
non 1966a. *Parapuzosia* sp. nov. (?) aff. *P. daubréei* (de Grossouvre); Matsumoto (p. 283, pl. 31, fig. 1).
1982. *Parapuzosia daubréei* (de Grossouvre, 1894); Immel, Klinger & Wiedmann (p. 11, pl. 2, fig. 9-10; pl. 3, fig. 1-2; pl. 4, fig. 2).
1983. *Parapuzosia daubrei* (de Grossouvre); Collignon (p. 189).
1988. *Parapuzosia daubréei* (de Grossouvre), 1893; Thomel (p. 28, pl. 19).
1995. *Parapuzosia* (*Parapuzosia*) *daubreei* (de Grossouvre, 1894); Kennedy & Kaplan (p. 26, pl. 31, 32).

Types : Lectotype, here designated, is the original of de Grossouvre, 1894 (pl. 28), said to be in the EMP Collections. We have not traced the original, but illustrate (Fig. 10) a cast in the MNHP Collections. The original was from the Santonian 'Marnes bleues à *Mortoniceras texanum*, situées sous le banc à *Lima marticensis*, au bas du chemin de Sougraignes aux Croutets (Aude)'. De Grossouvre mentions a number of other specimens which rank as paralectotypes, which we have not traced.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
MNHP R7979	270.0 (100)	60.0 (22.2)	116.5 (43.1)	0.52	71.2 (26.3)

Description : The lectotype was said by de Grossouvre to have its original shell preserved; the maximum preserved diameter of cast MNHP R7979 is 270 mm in diameter. Coiling is fairly evolute, with 62 % of the previous whorl covered, the umbilicus shallow, with a low, flattened, outward-inclined umbilical wall and narrowly rounded umbilical shoulder. The whorl section, modified by *post-mortem* crushing, is compressed (whorl breadth-to-height ratio 0.52), with broadly rounded flanks and a narrow, arched venter. There are 32 main ribs on the outer whorl. Most arise at the umbilical shoulder from well-developed bullae; a few lack bullae, or may arise low on the flank, notably on the first half whorl of the specimen. The ribs are strong, narrow and distant, straight and prorsiradiate on the inner flank, feebly flexed and convex around the middle of the flank, flexing forwards and concave on the outer flank, where they increase by branching and intercalation to give a total of 50 ribs at the ventrolateral shoulder, corresponding to 16 main ribs on the adapical part of the outer whorl. The secondary and intercalated ribs are sharp, narrow, prorsiradiate and concave, sweeping forwards and coarsening to cross the venter in a broad convexity.

A second specimen, MNHP R51707 (Fig. 11) is labelled 'Sougraigne'. Some 200 mm in diameter, it has around 24 main ribs on the outer whorl, but is otherwise similar to the lectotype. Much smaller is UPST S1, a small 120° body chamber fragment with a maximum preserved whorl height of 55 mm. There are nine main ribs and a total of 44 ribs at the ventrolateral shoulder.

Discussion : Coarse and more numerous main ribs that branch into coarse secondaries plus fewer, coarser and shorter intercalated ribs immediately separate *P.* (*P.*) *daubreei* from *P.* (*P.*) *corbarica* (de Grossouvre, 1894) (p. 174, pl. 27, fig. 1 : see below). *P.* (*P.*) *leptophylla* (Sharpe, 1857) (p. 48, pl. 21, fig. 2; pl. 22, fig. 1) appears to lack secondary and intercalated ribs.

Occurrence : Santonian *gallicus* and *paraplanum* Subzones in the Corbières. Santonian or Lower Campanian of Germany; Santonian of Brandenberg/Tirol, Austria.

Parapuzosia (*Parapuzosia*) *corbarica* (de Grossouvre, 1894)
Pl. 2, fig. 9; Pl. 5, fig. 1-3; Figs. 12, 13

1894. *Puzosia corbarica* de Grossouvre (p. 174, pl. 27, fig. 1).
1921b. *Parapuzosia daubréei* Grossouvre; Spath (p. 225).
1922. *Parapuzosia corbarica* Grossouvre; Spath (p. 126).
1925. *Puzosia* (*Parapuzosia*) *corbarica* Grossouvre; Diener (p. 129).
non 1936. *Parapuzosia corbarica* de Grossouvre; Renz (p. 5, pl. 4, fig. 1, 2 (= *P.* (*P.*) *boesei* Scott & Moore, 1928)).
? 1939. *Parapuzosia* cf. *corbarica* de Gross.; Basse (p. 39, 41).
1966a. *Parapuzosia daubreei* (de Grossouvre); Matsumoto (p. 280, pl. 31, fig. 2).
1966a. *Parapuzosia corbarica* (de Grossouvre); Matsumoto (p. 279, text-fig. 3).
? non 1979. *Parapuzosia corbarica* (de Grossouvre); Collignon *et al.* (p. 389, pl. 2, fig. 6 (= indeterminate)).
1982. *Parapuzosia corbarica* (de Grossouvre, 1894); Immel, Klinger & Wiedmann (p. 12, pl. 3, fig. 3; pl. 4, fig. 1).
1983. *Parapuzosia corbarica* (de Grossouvre); Collignon (p. 190).
1995. *Parapuzosia corbarica* (de Grossouvre, 1894); Kennedy & Kaplan (p. 27, pl. 34).

Types : Holotype, by original designation, is the original of de Grossouvre, 1894 (pl. 27, fig. 1), SP unregistered *ex* Toucas Collection (Fig. 12), from the 'Marnes Bleues de Sougraigne, Chemin de Sougraigne aux Croutets, Aude'. There are two paratypes from the environs of Bugarach (Aude) which we have not traced.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP (Pl. 5, fig. 1-3)	63.5 (100)	20.8 (32.7)	29.2 (46.0)	0.71	15.0 (23.6)
Holotype (Fig. 12)	152 (100)	38.0 (25.00)	64.5 (42.4)	0.59	43.0 (28.7)

Description : SP unregistered (*ex* Toucas Collection) is a juvenile 63.5 mm in diameter, from Sougraigne (Pl. 5, fig. 1-3). Coiling is moderately evolute, the umbilicus comprising 23.6 % of the diameter, shallow, with a low, flattened wall and narrowly rounded umbilical shoulder. The inner flanks are feebly inflated, the outer flanks flattened and convergent, the ventrolateral shoulders narrowly rounded, and the venter very feebly convex. Where shell is preserved, there are narrow, strong distant primary ribs, four per half whorl, feebly prorsiradiate and feebly sinuous on the flanks and projected strongly forwards on the ventrolateral shoulders to cross the venter in a feeble convexity. A weak constriction is associated with each of these ribs on the internal mould. On both shell and mould the primary ribs are separated by about 16 much weaker ribs that parallel the stronger primaries. They are particularly weak on the flanks, and strengthen markedly over ventrolateral shoulders and venter.

FIGURE 10

Parapuzosia (*Parapuzosia*) *daubreei* (de GROSSOUVRE, 1894).
A cast of the missing lectotype, the original of which was in the Collections of the École des Mines, figured by de GROSSOUVRE, 1894 (pl. 28) and from the 'Marnes bleues à *Lima marticensis*, au bas du chemin de Sougraigne aux Croutets (Aude)'. Reduced x 0.7.

FIGURE 11
Parapuzosia (*Parapuzosia*) *daubreei* (de GROSSOUVRE, 1894). MNHP R51707, Santonian, Sougraigne. Reduced × 0.75.

The holotype (Fig. 13) is a large, well-preserved individual deformed into an ellipse with a major diameter of 152 mm. Coiling is moderately evolute, with 58 % of the previous whorl covered. The umbilicus is shallow, comprising 28.7 % of the diameter, the umbilical wall flattened, with a narrowly rounded umbilical shoulder. The whorls are compressed (whorl breadth-to-height ratio 0.59) with very feebly convex flanks and more narrowly rounded ventrolateral shoulders and venter. There are 11 very distant, major primary ribs. They arise from weak bullae and are strong, narrow, straight and prorsiradiate on the inner half of the flank, beyond which they weaken, flex forwards, are feebly convex, and may branch. Weaker long and short narrow ribs arise as mere striae on the inner flanks, numbering up to 20 between major ribs. All ribs sweep forwards over the ventrolateral shoulder and cross the venter in a narrow, linguoid convexity.

MNHP 51076 (Fig. 12) was figured by MATSUMOTO (1966a : pl. 31, fig. 2) as an example of *Parapuzosia daubreei*, but belongs to the present species. It is from the Santonian of the environs of Rennes-les-Bains, and 120 mm in diameter. It shows a marked crowding of the primary ribs on the last 90° of the outer whorl.

Discussion : *P.* (*P.*) *daubreei* (Fig. 10) seems to be a much larger species than *P.* (*P.*) *corbarica*, with more and coarser primary ribs per whorl which branch on the outermost flank with few short secondary ribs separating successive primaries. *P.* (*P.*) *leptophylla* (SHARPE, 1857) (p. 48, pl. 21, fig. 2; pl. 22, fig. 1) was originally described from the Upper Chalk of southern England. The lectotype is from the Santonian *Micraster coranguinum* Zone of Greenhithe, Kent (BMNH C18130 : see KENNEDY & KAPLAN 1995); 315 mm in diameter it is a phragmocone with 13 crowded primary ribs on the last half whorl and no secondaries.

Occurrence : Coniacian *serratomarginatus* Zone and Santonian *gallicus* and *paraplanum* Subzones in the Corbières. There are also records from the Santonian of Brandenberg/Tirol, Austria. WIEDMANN (1960, 1964) recorded *P.* cf. *corbarica* from the Coniacian of northern Spain.

FIGURE 12
Parapuzosia (*Parapuzosia*) *corbarica* (de GROSSOUVRE, 1894).
MNHP R51706, 'Santonien, environs de Rennes-les-Bains'. Figures are x 1.

Parapuzosia (*Parapuzosia*) sp.
Pl. 5, fig. 4-8

Discussion : What appears to be a further species of *Parapuzosia* (*Parapuzosia*) is represented by three specimens. The inner whorls are distinctly *Puzosia*-like (Pl. 5, fig. 5-7); PM PN IX at a diameter of approximately 90 mm has an estimated eight to nine constrictions per whorl with up to nine primary, secondary and intercalated ribs between UPST C1 (Pl. 5, fig. 4, 8) shows such inner whorls to be succeeded by a growth stage with slightly flexuous, prorsiradiate primary ribs only. This ornament easily separates the material from both *P.* (*P.*) *corbarica* and *P.*(*P.*) *daubreei*, described above. The single primary ribs recall the ornament of *P.* (*P.*) *leptophylla* (SHARPE, 1857) (p. 48, pl. 21, fig. 2; pl. 22, fig. 1), of which it may be an ally.

Occurrence : Coniacian *petrocoriensis* and *tridorsatum* Zones of the Corbières.

Genus *Mesopuzosia* MATSUMOTO, 1954

Type species : *Mesopuzosia pacifica* MATSUMOTO, 1954 (p. 82, pl. 14, fig. 1; pl. 15, fig. 1, 2; pl. 16, fig. 1-3; text-fig. 2) by original designation by MATSUMOTO, 1954, (p. 79).

Mesopuzosia sp. juv.
Pl. 13, fig. 3

Discussion : PM K1-11 is a juvenile *Mesopuzosia* with an estimated original diameter of 53 mm. There are an estimated four strong prorsiradiate constrictions on the last half whorl with associated collar ribs, the adapical one strengthened markedly over the venter, with numerous weaker ribs between collars.

Occurrence : Upper Coniacian *serratomarginatus* Zone in the Corbières.

Genus *Jimboiceras* MATSUMOTO, 1954

Type species : *Desmoceras planulatiforme* JIMBO, 1894 (p. 27, pl. 1, fig. 4), by original designation by MATSUMOTO, 1954 (p. 95).

Jimboiceras ? *reyi* COLLIGNON, 1983
Pl. 4, fig. 8-11, 15, 16; Pl. 6, fig. 1

? 1873. *Ammonites* sp. indet. cf. *Ammonites sacya* FORBES; REDTENBACHER (p. 125, pl. 30, fig. 4).
1983. *Jimboiceras reyi* COLLIGNON (p. 189, pl. 2, fig. 2).

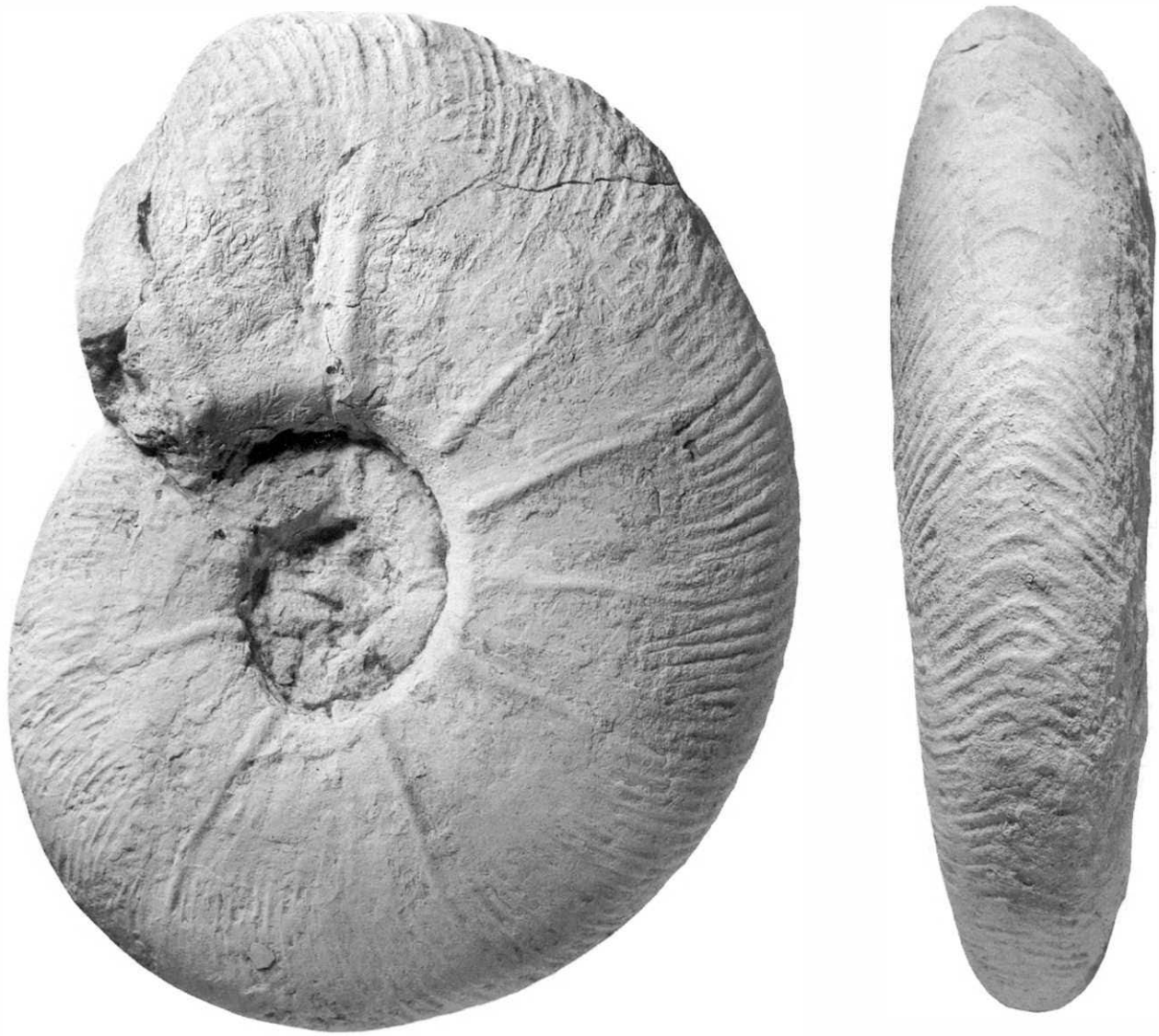

FIGURE 13

Parapuzosia (*Parapuzosia*) *corbarica* (de GROSSOUVRE, 1894).
Holotype, an unregistered specimen in the Sorbonne Collections, from the 'Calcaires marneux, inférieurs au banc à *Lima marticensis* de la montée de Sougraigne aux Croutets (Aude)', the original of de GROSSOUVRE, 1894 (pl. 27, fig. 1). Figures are × 1.

Type : Holotype, by original designation, is UPST MB 22 PR, the original of COLLIGNON, 1983 (pl. 2, fig. 2) (Pl. 4, fig. 15, 16), from the Upper Coniacian of Les Pastressis, Soulatgé, Corbières, Aude.

Description : Several additional specimens have been collected since the original description of this species : PM RO-20, RO-18, K1b 24, K1a1. Small, maximum diameter 53.5 mm. Coiling evolute, the umbilicus comprising 39 % of diameter, shallow, with a broadly rounded wall and shoulder. The whorls expand slowly. Whorl section modified by *post-mortem* distortion, but originally compressed, with flattened flanks and broadly rounded ventrolateral shoulders and venter. There are four to five very widely separated, primary collar-ribs per whorl. These arise at the umbilical shoulder and may be strengthened into feeble bullae. They are narrow, feebly prorsiradiate on the inner flank, markedly convex on middle and outer flank, projected strongly forwards and strengthened to cross the venter in a narrow linguoid peak. A feeble constriction is associated with the adapertural flank of collar-rib, and the adapertural side of these constrictions may be strengthened into a very feeble collar. Interspaces between ribs are smooth on body-chambers or may bear occasional obscure ribs and constrictions. The adapertural end of the phragmocone of one specimen shows traces of delicate prorsiradiate riblets on the ventrolateral shoulders and venter, and associated faint prorsiradiate flank striae. This specimen (PM K1a1) shows a corroded suture, with narrow E/L and L/U_2, with L broad and trifid.

Discussion : These curious ammonites are tentatively interpreted following COLLIGNON (1983), as *Jimboiceras* in which the intercalated ribs between primary collar ribs are lost, and in this respect they are easily separated from *J. planulatiforme* (JIMBO 1894) (p. 27, pl. 1, fig. 4; see MATSUMOTO, 1954 : p. 96, pl. 20, fig. 1-4; 1988, p. 89, fig. 36-41) and var. *madagascariensis* COLLIGNON, 1961 (p. 43, pl. 7, fig. 2) of the Turonian.

The figure of *Ammonites* sp. ind. cf. *Ammonites sacya* FORBES of REDTENBACHER (1873 : p. 125, pl. 30, fig. 4) from the Coniacian of Glanegg, Austria, has the same form and spacing of constrictions

as the present material and traces of delicate secondary ribs, and may be conspecific. Immel *et al.* (1982 : p. 19, pl. 5, fig. 7(?); pl. 6, fig. 5-7; pl. 7, fig. 1) referred this specimen to their new species *Patagiosites redtenbacheri*, and described specimens from the Santonian of Brandenberg/Tirol, Austria. This has serpenticone inner whorls with widely separated, sinuous collar-ribs and constrictions, while at the largest diameter known, there are feebly sinuous pairs of collar-ribs and associated rather broad constrictions. Form of constrictions and associated ribs is quite different from that of *Jimboiceras* ? *reyi*, and if not a gaudryceratid, the species is a remarkable homoeomorph of that group. It is not a *Patagiosites*.

Occurrence : Coniacian *tridorsatum* to *serratomarginatus* Zones in the Corbières. Also known from the Coniacian of Austria.

Jimboiceras ? sp.
Pl. 4, fig. 18-20

Description : A second *Jimboiceras* ? species is represented by PM S01, a partially septate individual 53 mm in diameter. Coiling appears to have been evolute, the umbilicus comprising an estimated 35 % of the diameter. The whorl section is depressed, with a whorl breadth-to-height ratio of 1.18, the flanks feebly convex, ventrolateral shoulders more narrowly rounded, the venter very broad, and feebly convex. There are ten distant, narrow, primary ribs per whorl, straight-to-recti to feebly prorsiradiate on the flanks, projected feebly forwards across the ventrolateral shoulders and very feebly convex across the venter. The ribs are succeeded by very weak, narrow constrictions.

Discussion : Depressed whorl section, more massive whorls and more numerous, less markedly concave and projected primary ribs that seemingly lack bullae separate this specimen from *Jimboiceras* ? *reyi*, described above.

Occurrence : PM SO1 is from the Coniacian *tridorsatum* Zone of Soulatgé, Corbières, Aude.

Genus *Hauericeras* de Grossouvre, 1894
(= *Schlueteria* Rollier, 1922 (p. 359),
non Fritsch *in* Fritsch & Kafka, 1887 (p. 33))

Pseudogardenia Tomlin, 1930 (p. 23)

Type species : *Ammonites gardeni* Baily, 1855 (p. 450, pl. 11, fig. 3), by original designation by de Grossouvre, 1894 (p. 219).

Subgenus *Gardeniceras* Matsumoto & Obata, 1955

Type species : *Ammonites gardeni* Baily, 1855 (p. 450, pl. 11, fig. 3), by original designation by Matsumoto & Obata, 1955 (p. 134).

Hauericeras (*Gardeniceras*) *welschi* de Grossouvre, 1894
Pl. 3, fig. 12; Pl. 4, fig. 3-5; Fig. 14.

1894. *Hauericeras welschi* de Grossouvre (p. 222, pl. 35, fig. 9).
1925. *Hauericeras welschi* de Grossouvre; Diener (p. 96).
1939. *Hauericeras Welschi* de Grossouvre; Basse (p. 46, pl. 3, fig. 9).
non 1983. *Hauericeras* aff. *welschi* de Grossouvre; Collignon (p. 192) (= *Saghalinites* sp.)

Types : de Grossouvre based this species on two syntypes, neither of which have been traced. Lectotype designation is inadvisable until the status of this material is clarified.

Description : Pyritic nuclei referred to this species are as small as 8.5 mm diameter (Pl. 4, fig. 3). Coiling is evolute at this stage, the umbilicus comprising 39 % of the diameter, shallow, with an outward-inclined umbilical wall. The whorl section is compressed

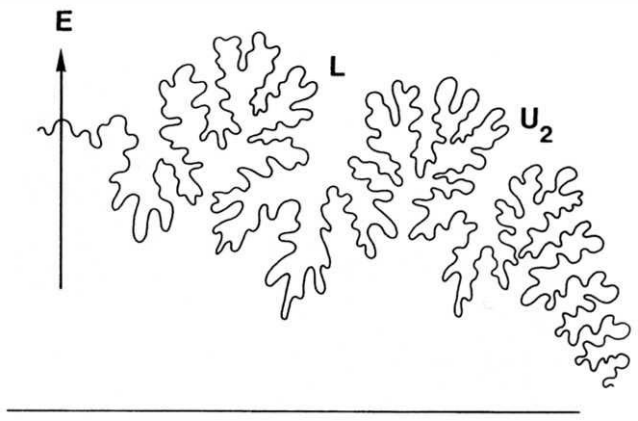

Figure 14

External suture of *Hauericeras* (*Gardeniceras*) *welschi* de Grossouvre, 1894.
UM-SEN 039, the original of Basse, 1939 (pl. 3, fig. 9) from the pyritic Upper Santonian *paraplanum* Subzone of La Jouane.
Bar scale is 10 mm.

(whorl breadth-to-height ratio around 0.7), with feebly convex to flattened flanks and a narrowly arched venter on internal moulds. There are five very slightly prorsiradiate, feebly sinuous constrictions per whorl, that form a very obtuse chevron on the venter. Somewhat larger is the pyritic fragment figured by Basse (1939) (Pl. 4, fig. 4, 5), 28.3 mm in diameter, the umbilical diameter 32 %, with a whorl breadth-to-height ratio of 0.57, the inner flanks feebly convex, the outer flanks convergent, and the venter narrowly arched on the mould. The half whorl bears two weak, broad feebly sinuous constrictions, feebly convex on the inner flank, feebly convex on the outer flank and crossing the venter in a slightly obtuse rounded peak. L3S1 (Pl. 3, fig. 12) is a crushed composite mould 43 mm in diameter, the coiling evolute, the umbilicus broad and shallow, the flanks feebly convex, although original proportions cannot be determined; there is a pronounced siphonal keel. There are an estimated 5-6 constrictions per whorl, feebly prorsiradiate and straight to feebly convex on the inner flank and projected forwards and concave on the outer flank.

A larger UPST fragment from the Montagne de Brenz matches the last half of de Grossouvre's specimen. The dimensions of the latter are, from the photograph D = 78.8 (100); Wb = 31.8 (24.5); U = 27.4 (34.8). The whorl breadth-to-height ratio of the Brenz fragment is 0.4. Constrictions are only feebly prorsiradiate or rectiradiate, and sinuous to feebly biconcave.

Discussion : de Grossouvre distinguished *H.* (*G.*) *welschi* from the type species, *H.* (*G.*) *gardeni*, on the basis of its higher whorls, overlapping to a greater extent, and less flexuous constrictions. The constrictions of *H.* (*G.*) *gardeni* are in fact strongly concave (see Immel *et al.*, 1982 : pl. 6, fig. 3) and more strongly projected on the ventrolateral shoulder.

Occurrence : Santonian *gallicus* and *paraplanum* Subzones, Corbières, Aude.

Hauericeras (*Gardeniceras*) cf. *gardeni* (Baily, 1855)

compare :
1855. *Ammonites gardeni* Baily, 1855 (p. 450, pl. 11, fig. 3).
1979. *Hauericeras* (*Gardeniceras*) *gardeni* (Baily); Summesberger (p. 133, pl. 6, fig. 27; text-fig. 19 (with synonymy)).
1982. *Hauericeras gardeni* (Baily, 1855); Immel, Klinger & Wiedmann (p. 16, pl. 5, fig. 1-4; pl. 6, fig. 1-4; text-fig. 5).

Discussion : PM B4-2 is a 90° sector of body chamber with an estimated maximum preserved whorl height of 24 mm. Two strong,

narrow concave constrictions are present, and are strongly projected on the ventrolateral shoulder. Form of constrictions suggests reference to *H.* (*G.*) *gardeni*.

Occurrence : *H.* (*G.*) *gardeni* ranges from Upper Santonian to Lower Campanian, with records from Austria, Zululand and Natal (South Africa). The Corbières specimen is from the Middle Santonian *gallicus* Subzone.

Hauericeras (*Gardeniceras*) *lagarum* (Redtenbacher, 1873)
Pl. 4, fig. 17

1873. *Ammonites lagarus* Redtenbacher (p. 112, pl. 25, fig. 3).
1901. *Hauericeras lagarum* Redtenbacher; de Grossouvre (p. 638).
1925. *Hauericeras lagarum* Redtenbacher; Diener (p. 95).
1935. *Hauericeras lagarum* (Redtenbacher); Brinkmann (p. 3).
1961. *Hauericeras lagarum* Redtenbacher; Collignon (p. 95).
1985. *Hauericeras lagarum* (Redtenbacher); Summesberger (p. 150, 151).

Types : Redtenbacher based the original figure of this species on two specimens which rank as syntypes.

Description : PM LOa1 (Pl. 4, fig. 17) is uncrushed and retains extensive areas of recrystallized shell; 52.5 mm in diameter, it has an umbilical ratio of 36 %, the umbilicus broad and shallow with a low wall and very narrowly rounded umbilical shoulder. The flanks are feebly convex to flat, converging ventrally; the siphonal keel is strong. There is a single broad, feebly concave constriction towards the adapical end.

Discussion : The Corbières material is firmly dated as Middle Coniacian, as is the type material of *Hauericeras* (*Gardeniceras*) *lagarum* (Summesberger, 1985). Redtenbacher (1873 : pl. 25, fig. 3) provided a composite figure of the species based on two individuals. No constrictions are shown in the illustration, which appears to be of a specimen that retains the original shell. The constrictions of the present material are fewer than in the type species *H.* (*G.*) *gardeni*, where they are markedly concave, and also *H.* (G.) *welschi*, described above, where the whorls are higher and the constrictions markedly flexuous.

Occurrence : The type material is from the Middle Coniacian of the Gosau Basin, Austria. Middle Coniacian *tridorsatum* Zone in the Corbières.

Juvenile Puzosiinae
Pl. 10, fig. 7, 8; Fig. 15

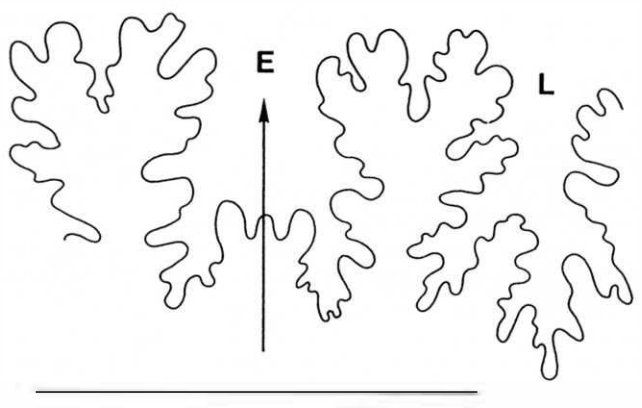

Figure 15

External suture of a juvenile puzosiine, *Parapuzosia gaudama* Forbes of Basse, 1939 (pl. 3, fig. 10).
UM-SEN 040, from the pyritic Upper Santonian *paraplanum* Subzone fauna of La Jouane. Bar scale is 10 mm.

1939. *Parapuzosia gaudama* Forbes; Basse (p. 48, pl. 3, fig. 10, text-fig. 4a, b).

Discussion : The *Parapuzosia gaudama* of Basse is a pyritic juvenile only 16.4 mm in diameter; it retains much of its original shell. There are two narrow, strongly prorsiradiate constrictions, 90° apart, straight on the flanks but projected forwards across the ventrolateral shoulder to form a slightly obtuse ventral chevron. The shell between constrictions is ornamented by delicate riblets and striae, at one point arising in a bunch of three or four from an obscure umbilical bulla. The specimen bears no relationship to *Mesopuzosia gaudama* (Forbes, 1846) (see Kennedy & Henderson, 1991 : p. 891, fig. 1.1-1.4).

Occurrence : Santonian *paraplanum* Subzone. Marnes Bleues de Sougraigne, La Jouane.

Subfamily Desmoceratidae Zittel, 1895
Genus *Desmophyllites* Spath, 1929
(= *Schlüteria* de Grossouvre, 1894 (p. 126) (*non* Fritsch in Fritsch & Kafka, 1887 : p. 33); *Schlütericeras* Collignon, 1938 (p. 92) (*non* Hyatt, 1903 : p. 110).

Type species : *Desmoceras larteti* Seunes, 1892 (p. 19, pl. 12(3), fig. 2, pl. 13(4), fig. 2, 3), by subsequent designation by Spath, 1921a (p. 46) as type species of *Schlueteria*, of which *Desmophyllites* is replacement name.

Desmophyllites diphylloides (Forbes, 1846)
Pl. 4, fig. 1, 2, 6, 7, 14; Fig. 16

1846. *Ammonites diphylloides* Forbes (p. 105, pl. 8, fig. 8).
1894. *Desmoceras pyrenaicum* de Grossouvre (p. 168, (*pars*), pl. 37, fig. 9 only).
1901. *Desmoceras salsense* de Grossouvre (p. 463).
1983. *Desmophyllites diphylloides* Forbes; Collignon (p. 191).
1992a. *Desmophyllites diphylloides* (Forbes, 1846); Kennedy & Henderson (p. 405, pl. 6, fig. 1-9; pl. 16, fig. 1-3, 7-8; pl. 17, 4-7; text-fig. 3f (with full synonymy)).

Types : Lectotype, by the subsequent designation of Matsumoto & Obata (1955 : p. 122) is no. C22682 in the collections of the Natural History Museum, London, the original of Forbes, 1846 (pl. 8, fig. 8); paralectotypes are BMNH C22683-5, all from the Upper Maastrichtian Valudavur Formation of Pondicherry, South India.

Discussion : *Desmophyllites diphylloides* is one of the commonest ammonites in the pyritic faunas of the Marnes Bleues de Sougraigne : we have seen more than 30 juveniles, up to 20 mm in diameter, some retaining original aragonitic shell (Pl. 4, fig. 6, 7), with delicate prorsiradiate growth lines and striae on the flank

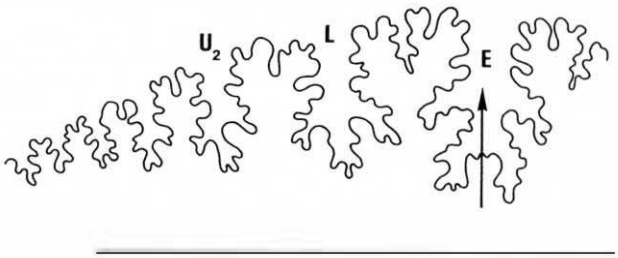

Figure 16

External suture of *Desmophyllites diphylloides* (Forbes, 1846).
UM SEN 041, from the pyritic Middle Santonian *gallicus* Subzone fauna of La Jouane. Bar scale is 5 mm.

that form a narrow linguoid peak over the venter, periodically strengthened into widely spaced ventrolateral and ventrolateral ribs that mark the site of constrictions on the internal mould (Pl. 4, fig. 2, 6). These number around four per half whorl, are concave on the inner flank, projected strongly forwards on the middle to outer flank and convex on ventrolateral shoulders and venter. A much larger crushed individual best referred to as *D.* cf. *diphylloides* (Pl. 4, fig. 14) is 73.5 mm in diameter.

Kennedy & Henderson (1992a) revised the type material of this species, and Henderson & McNamara (1985) described an extensive suite of larger individuals from Western Australia; both discuss differences from other species.

Occurrence : Lower Santonian to Upper Maastrichtian. In the Corbières the species is known from the *gallicus* and *paraplanum* Subzones. Elsewhere, it is known from South India, Western Australia, Japan, Alaska, British Columbia, California, Argentina, Angola, Pondoland and Zululand (South Africa), Tunisia and Northern Ireland.

Genus *Damesites* Matsumoto, 1942
(ICZN name no. 1349)
(= *Kotoceras* Yabe, 1927 (p. 36)
(ICZN rejected name no. 1264, *non* Kobayashi, 1934 (p. 391); *Neokotôceras* Anderson, 1958 (p. 219)).

Type species : *Desmoceras damesi* Jimbo, 1894 (p. 172, pl. 1, fig. 2, 3); ICZN Opinion 555, 1959.

Damesites sugata (Forbes, 1846)
Pl. 3, fig. 5, 6, 17, 18; Pl. 4, fig. 21

1846. *Ammonites sugata* Forbes (p. 113, pl. 10, fig. 2).
1983. *Damesites sugatus* (Forbes); Collignon (p. 190, pl. 2, fig. 4).
1983. *Damesites* aff. *compactus* (Van Hoepen); Collignon (p. 190, pl. 2, fig. 3).
1989. *Damesites sugata* (Forbes, 1846); Haggart (p. 195, pl. 8.4, fig. 14-23 (with synonymy)).
1991. *Damesites sugata* (Forbes, 1846); Kennedy & Henderson (p. 471, fig. 1, 2 (with synonymy)).

Types : The lectotype is no C22674 in the collections of the Natural History Museum, London, the original of Forbes, 1846 (pl. 10, fig. 2); paratypes are C22675 (of which C3561a is a further fragment), and C24196a-b, said to be from Vridachellum (Verdachellum), Madras State, South India, although perhaps from elsewhere, as discussed by Kennedy & Henderson (1991 : p. 474).

Discussion : We are uncertain as to the relationship between *Damesites sugata* (the types of which were revised by Kennedy & Henderson, 1991) and *Damesites compactus* (Van Hoepen, 1921) (p. 21, pl. 4, fig. 5-7), the holotype of which is only 18.2 mm in diameter with a whorl breadth-to-height ratio of 0.83 and an umbilical diameter of 10 % according to Van Hoepen. The lectotype of *Damesites sugata* is 37 mm in diameter, the whorl breadth-to-height ratio 0.79 and the umbilical diameter 9.5 %. Van Hoepen distinguished the species on the basis of *compactus* having a lower keel, the greatest whorl breadth at the external edge of the flanks and constrictions that are slightly convex forwards on the middle of the flanks. Matsumoto & Obata (1955 : p. 132) thought the type material of *compactus* to be too small for certain specific comparison with *sugata*. Collignon (1961 : p. 70, pl. 26, fig. 4; text-fig. 8) examined a suite of specimens from the Upper Santonian of Madagascar and separated the two on the tendency of the umbilicus of *compactus* to become progressively larger as a diameter increased, the stouter whorl section, extreme 'finesse' of the constrictions, and sutural details. He cites the following dimensions for specimens of *compactus* :

D	*Wb:Wh*	*U*
42	0.83	10 %
52	0.84	10 %
53	0.80	15 %
56	–	13 %
68	0.88	18 %

Large Indian *D. sugata* are certainly much more compressed than the larger of these specimens; of those figured by previous authors, the stoutest individual figured by Stoliczka (1865 : pl. 32, fig. 4) has a whorl breadth-to-height ratio of 0.7. Measurement of the umbilical ratio of Collignon's photograph of his largest specimen gives a figure of 8 % rather than the 18 % cited by him. In the absence of a clear correspondence between Van Hoepen's type specimen and the Madagascan material, and lack of information on topotypes of *compactus* it is unwise to apply Van Hoepen's name to such specimens at this time, and the bulk of the Corbières material is referred to a variable *Damesites sugata*.

Occurrence : Upper Coniacian *margae* or *serratomarginatus* Zone, Santonian *carezi* and *gallicus* Subzones in the Corbières. The species has a known range from Coniacian to Upper Santonian (or perhaps, Lower Campanian), with records from South India, Madagascar, Zululand and Pondoland (South Africa), Japan and British Columbia.

Damesites damesi intermedius Matsumoto, 1954
Pl. 3, figs. 19, 20

1954. *Damesites damesi intermedia* Matsumoto (p. 270, pl. 22(6), fig. 4).
1955. *Damesites damesi intermedius* Matsumoto; Matsumoto & Obata (p. 131, pl. 27, fig. 1, 2).
1959. *Damesites damesi intermedius* Matsumoto; Matsumoto (p. 12, text-fig. 3-5, (with synonymy)).

Type : Holotype is no. H3269 in the collections of Kyushu University, from the Upper Yezo Group of the Urakawa Area, Hidaka Province, Hokkaido, illustrated by Matsumoto, 1954 (pl. 22(6), fig. 4) and Matsumoto & Obata, 1955 (pl. 27, fig. 2).

Description : UPST L2 (Pl. 3, fig. 19, 20) is a composite mould of what appears to be an adult 70 mm in diameter, with 260° of body chamber preserved. Coiling is very involute, the umbilicus tiny, with flattened to feebly concave flanks, broadly rounded ventrolateral shoulders and venter, the whorl breadth-to-height ratio 0.8; there is a sharp siphonal keel. The unweathered surface lacks all trace of riblets, growth lines or striae, but there are an estimated four narrow, delicate constrictions per whorl, straight to feebly concave on the innermost flank, feebly convex across the mid-flank and markedly concave on the outer flank, projecting forwards on the ventrolateral shoulders to define a long, very acute ventral rostrum.

Discussion : Course of growth lines separates this specimen and a possible second (PM K2a7) from *D. sugata*. *D. damesi damesi* (Jimbo, 1894) (Matsumoto, 1954 : p. 267, pl. 21(5), fig. 1-3; text-fig. 56(10), 57(11)) has well-developed riblets and lirae, notably on the outer flank and venter, plus spiral striations.

Occurrence : Lower Santonian *carezi* Subzone in the Corbières. In Japan, California and Saghalien the species occurs in the Coniacian-Santonian.

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

Type species : *Lewesiceras tongoboryense* Collignon, 1952 (p. 23, pl. 2, fig. 3).

FIGURE 17
Tongoboryceras canali (de GROSSOUVRE, 1894).
Holotype, MNHP R51859, from the 'Marnes à *Micraster brevis* sur le chemin de Nalzen à Freychenet (Ariège)'.
Figures are × 1.

Tongoboryceras canali (de GROSSOUVRE, 1984)
Pl. 10, fig. 13-15; fig. 17

1894. *Pachydiscus canali* de GROSSOUVRE (p. 195, pl. 38, fig. 2).
1906. *Pachydiscus* cf. *levyi* GROSSOUVRE; MACOVEI (p. 78-81).
1922. *Nowakites canali* de GROSSOUVRE; SPATH (p. 124).
1925. *Nowakites canali* de GROSSOUVRE; DIENER (p. 113).
1952. *"Nowakites" canali* de GROSSOUVRE; COLLIGNON (p. 27, 93).
1955. *Pachydiscus canali* de GROSSOUVRE; COLLIGNON (p. 29, 84).
1981. *Nowakites* (?) *macoveii* SZÁSZ (p. 104, pl. 2, fig. 1; ? *non* pl. 4, fig. 5; pl. 6, fig. 2; pl. 8, fig. 1-3).
1988. *Nowakites* (?) *macoveii* SZÁSZ; SZÁSZ & ION (? *non* pl. 6, fig. 5; pl. 8, fig. 1).

Type : Holotype, by original designation, is MNHP R51859, from 'le chemin de Nalzen à Freychenet (Ariège), dans un gisment à *M. brevis* où m'avait guidé M. Canal'. A second, paratype specimen was said to be from 'des couches à micrasters des environs des Escudiers, près St Louis (Aude)'; there is a specimen in the Muséum National d'Histoire Naturelle (no. B17444) labelled 'environs de St Louis' (Pl. 10, fig. 13), but we cannot say if this is the paratype.

Description : Other than the two specimens mentioned above, we have three additional specimens, PM PN I-III, from Peyrefitte, west of Padern. The smallest of these (Pl. 10, fig. 14, 15) is 62 mm in diameter, the coiling evolute, the whorls slowly expanding, depressed reniform, the umbilicus of moderate depth with markedly convex wall and shoulder. There are five strong umbilical bullae on the last half whorl. These give rise to one or two sharp coarse prorsiradiate ribs, while there are additional single, non-bullate primaries and long and short intercalated ribs to give a total of ≃ 20 ribs per half whorl at the ventrolateral shoulder. The ribs are straight across the flanks and cross the venter in a very shallow convexity. Periodic constrictions, four per half whorl, have associated collar-ribs. MNHP B17444 (Pl. 10, fig. 13) is the best-preserved of the larger specimens; 100 mm approximately in diameter, the whorl section is deformed, but appears originally to have been depressed and reniform. Coiling is evolute, the whorls overlapping to only a minor extent. Ornament is damaged, but consists of strong, narrow, widely spaced bullate primaries that are straight and prorsiradiate on the flanks and separated by a strong non-bullate adapical primary and a shorter, adapical intercalated rib.

The holotype (Fig. 17) is very poorly preserved, a worn mould in grey glauconitic limestone; the maximum preserved diameter is 94.5 mm. Coiling is evolute, with a broad, deep umbilicus, the whorl section depressed and reniform. There are six umbilical bullae preserved on the last half whorl, that give rise to broad, distant ribs, generally singly, while other ribs extend to the umbilicus without developing *a* tubercle. The ribs are straight and feebly prorsiradiate on the inner flank, and flex feebly forwards over the ventrolateral shoulder to cross the venter in a very shallow convexity. Single, short, intercalated ribs alternate regularly; they arise low on the flank, but strengthen to match the primary ribs in both strength and direction. The ribs crowd somewhat at the largest diameter preserved.

Discussion : SPATH (1922) referred *canali* to *Nowakites*; COLLIGNON (1952, 1955) thought it indeterminate. The additional material now described include sufficient features to show the species to be a *Tongoboryceras*, most closely related to *T. rhodanicum* (ROMAN & MAZÉRIN, 1913; see revision in WRIGHT, 1979 : p. 316, pl. 6, fig. 1, 7), from which it differs in minor details only, chiefly its less depressed whorl section and more numerous umbilical tubercles; they might even be conspecific, with *canali* the prior name.

There are no significant differences between the present material and the holotype of *Nowakites* (?) *macoveii* SZÁSZ, 1981, and most of the other specimens referred to that species are conspecific with

the present material (Szász, 1981 : pl. 2, fig. 1; pl. 6, fig. 2; pl. 8, fig. 1-3); the very fine-ribbed juvenile figured by Szász (1981 : pl. 4, fig. 5) seems very different and may belong elsewhere.

Occurrence : Lower Coniacian *petrocoriensis* Zone in the Corbières. Also recorded from the Lower Coniacian of Romania.

The *Pseudokossmaticeras brandti* of Szász (1981 : p. 102, pl. 5, fig. 1, 2) and *Pseudokossmaticeras* sp. (n. sp.) of that author (1981 : pl. 6, fig. 1) are allied forms; true *P. brandti* Redtenbacher, 1873, is an Upper Campanian species (Hancock & Kennedy, 1993).

Genus *Nowakites* Spath, 1922

Type species : *Pachydiscus carezi* de Grossouvre, 1894 (p. 190, pl. 25, fig. 3, pl. 37, fig. 5), by original designation by Spath, 1922 (p. 124).

Diagnosis : Small to medium-sized, moderately involute, whorl section rounded, depressed to compressed oval. Ornament consists of groups of narrow, distant, sharp primary ribs that arise from sharp umbilical bullae with several intercalated ribs of variable length between groups of primaries. Ribs generally prorsiradiate, concave, projected over venter. Broad constrictions with associated bullate collar-ribs prominent on inner whorls but declining on outer. Strongly dimorphic in some species at least; microconchs develop ventral tubercles only to loose them on the last part of the adult body, chamber whereas these are absent on macroconch.

Discussion : Spath referred the following to *Nowakites* : *Puzosia lemarchandi* de Grossouvre 1894 (p. 173, pl. 22, fig. 5); *Ammonites draschei* Redtenbacher, 1873 (p. 123, pl. 30, fig. 1); *Pachydiscus yokoyamai* Jimbo, 1894 (p. 30, pl. 2, fig. 3); *Pachydiscus canali* de Grossouvre, 1894 (p. 195, pl. 38, fig. 2); *Pachydiscus linderi* de Grossouvre, 1894 (p. 188, pl. 18; pl. 24, fig. 4); *Ammonites pailletteanus* d'Orbigny, 1841 (p. 339, pl. 102, fig. 3, 4) and *Sonneratia savini* de Grossouvre, 1894 (p. 152, pl. 25, fig. 4, pl. 37, fig. 4). Collignon (1952, 1955) reviewed the genus, as did Matsumoto (1955a, 1966b, 1979). The present study of Santonian specimens from the Corbières has shown that some larger typical *Nowakites* occur with much smaller individuals with prominent ventral tubercles. One of these was figured already by de Grossouvre (1894 : pl. 37, fig. 4) as a syntype of *Sonneratia savini*.

The following are here referred to the genus : *N. pailletteanus* (d'Orbigny, 1841), *N. talavignesii* (d'Orbigny, 1850), *N. flaccidicostata* (Roemer, 1852), *N. hernensis* (Schlüter, 1867), *N. draschei* (Redtenbacher, 1873), *N. lemarchandi* (de Grossouvre, 1894), *N. savini* (de Grossouvre, 1894), *N. carezi* (de Grossouvre, 1894), *N. jimboi* (Kossmat, 1897), *N. yubarensis* Matsumoto, 1979, *N. mikasaensis* Matsumoto, 1979.

Occurrence : Coniacian-Santonian, France, Spain, Germany, Austria, Sweden, Denmark, Armenia, South India, Japan, Madagascar, Texas.

Nowakites carezi (de Grossouvre, 1894)
Pl. 6, fig. 3, 6-8, 11, 12; Pl. 7, fig. 4, 5; Pl. 8, fig. 13-15; Pl. 9, fig. 2-4.

1894. *Pachydiscus carezi* de Grossouvre (p. 190, pl. 25, fig. 3, pl. 37, fig. 5).
1901. *Pachydiscus* cf. *carezi* de Grossouvre; Sturm (p. 60, pl. 3, fig. 6).
1922. *Nowakites carezi* de Grossouvre; Spath (p. 124).
1925. *Nowakites carezi* de Grossouvre; Diener (p. 113).
1952. *Nowakites Carezi* de Grossouvre; Collignon (p. 27, 85).
1955. *Nowakites Carezi* de Grossouvre; Collignon (p. 29, 78).
1957. *Nowakites carezi* (Grossouvre, 1894); Wright (p. L378, fig. 494, 4).
1970. *Nowakites carezi* Grossouvre; Atabekian & Akopian (p. 32, pl. 1, fig. 1 (with additional synonymy)).
1970. *Nowakites Le Marchandi* de Gross.; Boldor *et al.* (pl. 2, fig. 4).
1974. *Nowakites* sp. Szász & Lacatusu (pl. 2, fig. 2).
1981. *Nowakites carezi* (de Grossouvre), 1894; Szász (p. 103, pl. 4, fig. 4).
1982. *Nowakites carezi* (Grossouvre, 1894); Tzankov (p. 34, pl. 14, fig. 6).
1988. *Nowakites carezi* (de Grossouvre); Szász, & Ion (pl. 7, fig. 2).
? 1988. *Nowakites* cf. *carezi* (de Grossouvre), 1893; Thomel (p. 33, text-fig. 17).

Types : The holotype, by original designation, is the original of de Grossouvre, 1894 (pl. 25, fig. 3) (Pl. 9, fig. 2-4), an unregistered specimen in the MNHP Collections, from the 'Couches à micrasters des environs de Rennes-les-Bains (Aude)'. The paratype (de Grossouvre, 1894 : pl. 37, fig. 5) from the 'calcaires marneux à *Micraster brevis* de Borde-Neuve, près Rennes-les-Bains', has not been traced.

Description : The holotype is a crushed composite mould, distorted into an ellipse with a maximum diameter of 56.5 mm. Coiling is moderately involute, with a fairly deep umbilicus that comprises 30 % approximately of the diameter, the umbilical wall is flattened and outward-inclined, the umbilical shoulder more narrowly rounded. The inner flanks are broadly rounded, the outer flanks convergent, with broadly rounded ventrolateral shoulders and venter. There are 14 prominent umbilical bullae on the outer whorl that strengthen progressively as size increases. On the first half of the outer whorl these give rise to pairs of prorsiradiate ribs, straight on the inner flank, but swept forwards and concave on the outer flank to cross the venter in a broad convexity. There are occasional shorter intercalated ribs, and some interspaces are a little deeper than the others, defining poorly differentiated constrictions. Ribbing coarsens markedly on the last half whorl, with umbilical bullae giving rise to pairs of ribs initially, the ribs becoming single at the largest diameter preserved. There are one or two long or short intercalated ribs. Ribs are straight on the inner flank, projecting forwards and concave on the outer flank to produce a marked ventral convexity, although this has been accentuated by *post-mortem* crushing. There are a total of more than 50 ribs on the outer whorl, the final rib being succeeded by a broad, ill-defined constriction. The smaller paralectotype (not traced) is 35 mm in diameter and finely ribbed, with four prominent constrictions flanked by narrow, feebly bullate, primary ribs. Ribs between constrictions are both long and short, and may arise in pairs. This specimen can be matched with PM K2a18 (Pl. 7, fig. 4, 5), which shows the transition to the coarse-ribbed stage, as in the lectotype.

Discussion : The change from fine-ribbed early whorls with prominent constrictions to coarse-ribbed outer whorls with far less conspicuous constrictions characterises *Nowakites carezi*, and isolated early whorls (Pl. 6, fig. 7, 8, 11, 12) are highly distinctive. What may be the microconch of this species, is represented by PM H5-1 and PM G5c5 (Pl. 6, fig. 3) and possibly K1c19 (Pl. 6, fig. 6) where the fine-ribbed stage is succeeded by a brief stage with strengthened constrictions with coarsening collar-ribs that are particularly strong over the venter, while ribs between collars become weak and irregular. Ribs on the adapical end of the phragmocone bunch in places (Pl. 6, fig. 3) suggesting the presence of tubercles, but this impression cannot be confirmed due to imperfect preservation.

Nowakites talavignesii d'Orbigny, 1850 (Pl. 6, fig. 17-19) is a problematic species. Coiling is very evolute, as in *N. carezi*, but the holotype lacks the inner whorls so that early ontogeny cannot be compared. The outer whorl of *N. talavignesii* shows much more irregular ribbing than that of *N. carezi*. *Nowakites savini* (de Grossouvre, 1894 : p. 152, pl. 25, fig. 4; pl. 37, fig. 4) is coarsely ribbed throughout ontogeny, with prominent constrictions, is less evolute, with fewer bullae per whorl and more numerous non-bullate ribs.

Occurrence : Santonian *carezi* and *gallicus* Subzones in the Corbières. The species is also known from the Coniacian of Romania, Bulgaria and Armenia.

Nowakites talavignesii (d'Orbigny, 1850)
Pl. 6, fig. 15-19; Pl. 8, fig. 1-5, 8-12

1850. *Ammonites talavignesii* d'Orbigny (p. 190).
1894. *Sonneratia savini* de Grossouvre (p. 152 (*pars*), pl. *37*, fig. 4 only).
1952. *Nowakites tallavignesi* d'Orb.; Collignon (p. 28, 85, pl. 9, fig. 3).
1955. *Nowakites tallavignesi* d'Orb.; Collignon (p. 30, 78, pl. 9, fig. 3).
1970. *Nowakites tallavignesi* (d'Orbigny); Atabekian & Akopian (p. 30, pl. 9, fig. 3).
1981. *Nowakites tallavignesi* (d'Orbigny, 1850); Szász (p. 103, pl. 7, fig. 1-3).
non 1983. *Nowakites tallavignesi* (d'Orbigny); Collignon (p. 193, pl. 2, fig. 8 (= *N. savini*)).

Type : The holotype of *Ammonites talavignesii* d'Orbigny, 1850 (p. 190) was refigured by Collignon, (1952 : pl. 9, fig. 3; 1955 : pl. 9, fig. 3), and said to be in the d'Orbigny Collection, housed in the Muséum National d'Histoire Naturelle, Paris. It is currently housed in the collections of the Départment des Sciences de la Terre, Lyon, Cat. no. A1695 (Pl. 6, fig. 17-19).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
Holotype	59.0	26.3	22.5	1.17	20.3
(from cast)	(100)	(44.6)	(38.1)		(34.4)

Description : The holotype is a composite mould of the outer whorl only, deformed into an ellipse with a maximum preserved diameter of 59 mm (measurements taken from a cast). Coiling is very evolute, serpenticone, with the broad, deep umbilicus comprising 34.4 % of the diameter, the umbilical wall high, flattened, with a broadly rounded umbilical shoulder. The whorl section is depressed reniform, with the greatest breadth just outside the umbilical shoulder with whorl breadth to height ratio 1.17. There are an estimated eight umbilical bullae on the outer whorl. These give rise to pairs of ribs, while other primary ribs arise at the umbilical shoulder with occasional shorter intercalated ribs to give a total of 20 feebly sinuous ribs on the last half whorl. They are straight and feebly prorsiradiate on the inner flank, strengthening and concave on the outer flank, crossing the venter in a feeble convexity. There are variably and irregularly developed constrictions, as many as four per half whorl, flanked by primary, sometimes bullate ribs, and rib spacing is irregular, with some very wide interspaces, as 60° before the apertural end of the fragment.

Microconchs (Pl. 8, fig. 1-12) correspond to the missing paratype of *Nowakites savini* (de Grossouvre, 1894 : pl. 37, fig. 4), and are up to 45 mm in diameter. The specimen shown as Plate 8, figures 8-12 is 42 mm in diameter. Coiling is involute, the umbilicus comprising 38.3 % of the diameter, relatively shallow, with a low wall and narrowly rounded umbilical shoulder. The original whorl section cannot be determined because of crushing, but the flanks appear to have been broadly rounded, the ventrolateral shoulders more narrowly so; the expansion rate is low. An estimated 16 ribs arise on the umbilical wall, strengthening into bullae at the umbilical shoulder or not. Bullae give rise to one or two ribs, while there are additional long intercalated ribs to give a total of more than 40 ribs per whorl. The ribs are straight and prorsiradiate on the inner and middle flanks, flexing forwards and markedly concave on the outer flanks to cross the venter in a broad convexity. The ribs are highly irregular in development and strengthen on the outer whorl. The stronger ones are associated with broad, deep constrictions, four or five per whorl. Strong ribs bear small, sharp ventral tubercles on the adapertural part of the phragmocone of the outer whorl, and these are present on all but the last part of the body chamber; eleven or twelve are present in total. Flank ribs link either singly or in pairs at these tubercles. There is a pronounced constriction close to the terminal aperture. A second microconch (Pl. 8, fig. 1-5) is 45 mm in diameter, and differs in no significant respects from the previous specimen. A third (Pl. 8, fig. 6, 7) is referred to *N. talavignesii* with some doubt; it shows the beginning of the tuberculate stage, beyond which it has suffered massive non-lethal damage and shows striking pathological ornament. A further individual (Pl. 6, fig. 15, 16) may also belong here; it too shows pathological disturbance to the body chamber, resulting in a spurious siphonal node.

Discussion : The linking of tuberculate microconchs to the macroconch holotype of *N. talavignesii* is based upon the similar shell form with very evolute coiling, preponderance of long, bullate or non-bullate ribs with additional secondaries, the irregularity of ornament and constrictions.

Lack of inner whorls makes comparison of the holotype of *Ammonites talavignesii* with other *Nowakites* species difficult. It was not discussed by de Grossouvre, but is clearly a close ally of both *Nowakites carezi* (de Grossouvre, 1894), and *N. savini* (de Grossouvre, 1894). The former is characterised by finely ribbed, constricted inner whorls (e.g. the holotype, Pl. 9, fig. 2-4); the holotype of *talavignesii* is already coarsely ribbed at a diameter where fine ribbing persists in the former (see also Pl. 7, fig. 4, 5), while the former is ever more evolute, and there are more non-bullate ribs in *talavignesii* than *carezi*. The types of *N. savini* have not been traced. The holotype is much more involute, with U = 27 % of diameter versus 34.4 % in *talavignesii*, the ribs concave, with four to six umbilical bullae per half whorl and up to four non-bullate ribs separating bullate ones. The inner whorls are not visible in the holotype, but new material from the Corbières suggest coarse ribbing extends back onto the early whorls. The holotype of *Nowakites talavignesii* has, on its outer whorl at least, coiling that is closer to that of *N. carezi*, but ornament closer to that of *N. savini*.

Collignon (1983 : pl. 2, fig. 8) referred a coarse-ribbed juvenile to *N. talavignesii*; it is here regarded as a juvenile *N. savini*.

Occurrence : None of the specimens from the Corbiéres is precisely dated; localities are Sougraigne and Soulatgé. The species is also recorded from the Coniacian of Armenia and Romania.

Nowakites pailletteanus (d'Orbigny, 1841)
Pl. 6, fig. 20, 21, 24; Pl. 7, fig. 1-3, 6-12; Pl. 9, fig. 8; Pl. 10, fig. 16

1841. *Ammonites Pailletteanus* d'Orbigny (p. 339, pl. 102, fig. 3, 4).
1850. *Ammonites Pailletteanus* d'Orb., 1840; d'Orbigny (p. 212).
? *non* 1889. *Pachydiscus Pailleteanus* d'Orbigny; Peron (p. 23).
1894. *Sonneratia pailletti* d'Orbigny; de Grossouvre (p. 149, pl. 37, fig. 2).
1894. *Nowakites lemarchandi* de Grossouvre (p. 173, pl. 22, fig. 5).
1907. *Pachydiscus pailletianus* d'Orb.; Pervinquière (p. 176).
1913. *Ammonites pailleteanus* d'Orbigny; Nowak (p. 354).
1922. *Nowakites pailleteanus* d'Orbigny; Spath (p. 124).
1922. *Nowakites le marchandi* de Grossouvre; Spath (p. 124).
1925. *Nowakites Pailleteanus* d'Orbigny; Diener (p. 113).
1952. *Nowakites Paillettei* d'Orbigny; Collignon (p. 28, 85).
1952. *Nowakites le Marchandi* de Grossouvre; Collignon (p. 85).
1955. *Nowakites Paillettei* d'Orbigny; Collignon (p. 29, 78).
1955. *Nowakites le Marchandi* de Grossouvre; Collignon (p. 78).
1981. *Nowakites le marchandi* (de Grossouvre), 1894; Szász (p. 104, fig. 2, 3).
1983. *Nowakites paillettei* (d'Orbigny); Collignon (p. 192, pl. 2, fig. 7).
non 1983. *Nowakites le marchandi* (de Grossouvre); Collignon (p. 193, pl. 2, fig. 9 (= *N. savini*)).
1988. *Nowakites paillettei* (d'Orbigny), 1842; Thomel (p. 33).

Types : d'Orbigny (1841 : p. 340) recorded this species from a number of localities : "M. Palllette ingénieur civil des mines et moi avons recueilli cette espèce, entre Soulage et la Source-Salée, dans les Corbières (Aude), au sein d'un grès compact, que je rapporte à l'étage des grès verts supérieurs ou craies chloritées. M. Dufrenoy, l'a trouvée à Saint-Paul-Fenouillet (Aude). Elle est rare et toujours encroutée".

The catalogue of the d'Orbigny collection lists the following specimens :

'7187 T	*A. pailletteanus* d'Orbigny	Soulage	Aude	2
7187a	id	Tercis	Landes	2
7187b	id	Bidart	B. Pyrènèes	1
7187c	id	Haldem	Westphalie	1'

All these specimens survive. Those from Soulage (an error for Soulatgè) are the only specimens that are syntypes, the others coming from localities not mentioned by d'Orbigny; indeed, they belong to different genera. Sornay (1955a) refigured one view of each of the two syntypes (Pl. 7, fig. 6, 7, 9, 10) and designated the larger one (Pl. 7, fig. 9, 10) lectotype of the species.

The holotype, by monotypy, of *Nowakites lemarchandi* de Grossouvre, 1894 (p. 173, pl. 22, fig 5) is no 1908-36 in the Peron Collection, now in the MNHP Collections, from the 'Calcaires durs de la base de l'étage Coniacien, Environs de Montferrand (Aude)' (Pl. 7, fig. 1-3).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
type *lemarchandi*	64.5 (100)	– (–)	29.5 (45.7)	–	18.0 (27.9)

Description : The lectotype of *N. pailletteanus* is a poorly preserved internal mould in grey micaceous siltstone. The paralectotype is rather better preserved, with replaced shell present. Coiling is moderately involute, with a small, deep umbilicus, the width of which is exaggerated by compaction in the lectotype. Small, sharp umbilical bullae give rise to single ribs or groups of two or three ribs, with one or two non-bullate ribs between bullate groups and also arising at the umbilical shoulder. There are also occasional much shorter ribs inserted around mid-flank. The ribs are much narrower than the interspaces. Bullate ribs tend to be straight and prorsiradiate to mid-flank, but the non-bullate ribs may be feebly flexuous. All ribs sweep forwards on the outer flank and ventrolateral shoulder, to cross the venter in a broad convexity. It is not possible to determine accurately the number of ribs in either of the types due to poor preservation, but the lectotype is estimated to have had 60 per whorl. Neither show the sutures.

The holotype of *Nowakites lemarchandi* (Pl. 7, fig. 1-3) is worn and deformed into an ellipse; the dimensions are given above. Coiling appears to have been moderately evolute, the umbilicus comprising around 28 % of the diameter, and of moderate depth; the umbilical shoulder appears to have been quite broadly rounded. The whorls expand slowly, but the original whorl section cannot be determined, although the flanks appear to have been somewhat flattened, and the ventrolateral shoulders and venter broadly rounded. There are six to seven bullate primary ribs per half whorl, giving rise to one or two primary ribs with four to five slightly weaker long and short ribs between the bullate ones. The ribs are prorsiradiate, straight on the inner flank, but flexed forwards and concave on outer flank and ventrolateral shoulder and cross the venter in a broad convexity. Interspaces adapical to the bullae are in some cases deepened into feeble constrictions.

Discussion : The Coniacian parts of the Marnes à *Micraster* yield generally poorly preserved finely ribbed *Nowakites* referred to *N. pailletteanus* and '*Puzosia*' *lemarchandi* de Grossouvre (1894 : p. 173) did not even discuss the relationship between the two, which he referred to different genera. In his account of '*Sonneratia pailletteï* d'Orbigny' he made no reference to the type material, which he appears not to have examined. Emphasis was given to the alternation of flexuous long and short ribs and the absence of umbilical tubercles, while d'Orbigny's figure was reproduced. Only a single fragment was illustrated (Pl. 7, fig. 2), and this has a small bulla on the last rib. D'Orbigny's types (Pl. 7, fig. 6, 7, 9, 10) are very different from his figure : the ribs are not sinuous, and the lectotype shows quite clearly primary ribs with small umbilical bullae, such that I am inclined to regard *pailletteanus* and *lemarchandi* as conspecific. Some other specimens referred to the species (Pl. 7, fig. 8, 11, 12; Pl. 10, fig. 16) show a marked coarsening of ribs at large diameters, and may be adult.

Also present in the Coniacian of the Corbières are crushed, very finely ribbed *Nowakites* of *pailletteanus* type (Pl. 9, fig. 5; Pl. 11, fig. 4) with over 30 ribs per half whorl : they are here referred to as *Nowakites* aff. *pailletteanus*. De Grossouvre (1894 : p. 188, pl. 24, fig. 4) figured a specimen of this type from the 'Marnes à micrasters, Bugarach (Aude)', which he referred to his *Pachydiscus Linderi* of the 'partie inférieur du Sénonien'. The holotype of *linderi* is a *Pachydesmoceras*, and of Turonian age. The smaller specimen (de Grossouvre 1894 : pl. 24, fig. 4) has not been traced (like others in the Joseph Jean Collection). de Grossouvre subsequently (1901 : p. 443, footnote 3) realised that this specimen differed from true *linderi*, referred to it as '*P.* cf. *linderi*' and stated it to be of Santonian age; it is here shown to be more likely to be Coniacian.

Occurrence : Middle Coniacian *tridorsatum* Zone and Upper Coniacian *margae* Zone in the Corbières. The species is also known from the Coniacian of Romania.

Nowakites savini de Grossouvre, 1894
Pl. 8, fig. 16-23; Pl. 9, fig. 1, 6, 7; Pl. 19, fig. 7; Pl. 22, fig. 1, 2, 4, 5; Fig. 20C

1894. *Sonneratia savini* de Grossouvre (p. 152 (*pars*), pl. 25, fig. 4; *non* pl. 27, fig. 4).
1922. *Nowakites savini* Grossouvre; Spath (p. 124).
1925. *Nowakites savini* Grossouvre; Diener (p. 113).
1939. *Nowakites savini* de Gross.; Basse (p. 47).
1952. *Nowakites savini* de Grossouvre; Collignon (p. 29, 85).
1955. *Nowakites savini* de Grossouvre; Collignon (p. 30, 78).
1982. *Nowakites savini* (Grossouvre, 1894); Tzankov (p. 35, pl. 27, fig. 2).
1983. *Nowakites savini* (de Grossouvre); Collignon (p. 192, pl. 2, fig. 6).
1983. *Nowakites tallavignesi* (d'Orbigny); Collignon (p. 192 (*pars*), pl. 2, fig. 8).
1983. *Nowakites lemarchandi* (de Grossouvre), Collignon (p. 193 (*pars*), pl. 2, fig. 9).
? 1988. *Nowakites savini thomeli* (Collignon), 1981, Thomel (p. 34, pl. 3, fig. 1-3; pl. 4, fig. 3; pl. 22, fig. 1).

Types : Holotype, by original designation, is the original of de Grossouvre, 1894 (p. 152, pl. 25, fig. 4), in the Toucas Collection, from the 'Marnes bleues situées au-dessous du banc à *Lima marticensis* sur le chemin de Sougraigne aux Croutets (Aude)'. The paratype (de Grossouvre, 1894 : pl. 37, fig. 4) was from the environs of Soulatgé (Aude), and in the Gabelle Collection. Neither specimen has been traced; the latter is here regarded as a microconch *Nowakites talavignesii*.

Description : Specimens in the present collection are up to 83 mm diameter; the best preserved of these is UPST LSI (Pl. 9, fig. 6, 7). Coiling is involute, the umbilicus small, comprising around 26 % of the diameter, with a flattened wall and broadly rounded umbilical shoulder; it is crushed, and none of the Corbières specimens retain the original whorl section. Eight prominent, sharp bullae perch on the umbilical shoulder. They give rise to either a pair of ribs, or a single rib that bifurcates low on the flank, with up to four long or short ribs between bullate ones. The ribs are strong, narrow, straight on the inner flank and flexed forwards and strongly concave on outer flank and ventrolateral shoulder; they cross the venter in a broad convexity. There are periodic strong irregularly spaced constrictions, around three per half whorl. Other specimens referred to the species may be finer-ribbed (Pl. 8, fig. 18-23), and have constrictions that are more (Pl. 8, fig. 16, 17) or less (Pl. 8, fig. 21-23) prominent.

Discussion : *Nowakites savini* most closely resembles the type species, *N. carezi*; differences between the two are discussed above.

Occurrence : Santonian *carezi* and *gallicus* Subzones in the Corbières. Tzankov (1982) recorded the species from the Coniacian of Bulgaria.

Nowakites ? aff. *katschthaleri* (Immel, Klinger & Wiedmann, 1982)
Pl. 6, fig. 4, 5

1982. *Pseudomenuites katschthaleri* Immel, Klinger & Wiedmann (p. 20, pl. 7, fig. 2-5 (with synonymy)).

Type : Holotype, by original designation is no. 1981. I. 108 in the collections of the Bayerische Staatsammlung für Paläontologie und Historisches Geologie, München, the original of Immel *et al.*, 1982 (pl. 7, fig. 2), from the Santonian of Brandenberg/Tirol, Austria.

Description : PM K1c20 (**Pl. 6, fig. 4, 5**) is crushed and deformed into an ellipse, the major diameter of which is 36 mm. Coiling is very evolute, the umbilicus comprising 32 % of the diameter, shallow, with a convex wall. The whorls expand slowly; the original whorl section cannot be established. There are six constrictions on the outer whorl, 'generally succeeded by a relatively strong and variably bullate collar-rib that bears small ventral tubercles. In some cases a second rib may link at the tubercles on the collar.

On the first half of the outer whorl, there are up to two pairs of delicate primary ribs between the constrictions and collar-ribs, linked at weak ventral tubercles, the tubercles connected across the venter by a pair of looped ribs. On the last half whorl ribbing between collar-ribs coarsens markedly with up to four ribs of variable strength, generally single, and lacking ventral tubercles, as do the last few collar-ribs.

Discussion : The present specimen has the looped ribbing and tubercles of *Pseudomenuites katschthaleri*, but differs in the presence of well-developed constrictions and collar-ribs. it shares looped ribs, collars and constrictions with microconchs assigned to *Nowakites talavignesii* (Pl. 8, fig. 1-12) but the shell of the present species has a low expansion-rate and much more delicate ornament.

Occurrence : PM Klc 20 is from the Santonian *carezi* Subzone of the Chemin de La Jouane, Corbières, Aude.

Nowakites ? sp.
Pl. 6, fig. 13, 14

Discussion : PM P1-16 is crushed, poorly preserved, and 44.5 mm in diameter, but clearly a further microconch pachydiscid like those assigned to *Nowakites talavignesi* (Pl. 8, fig. 1-12), but with ornament on all but the last 60° sector of what appears to be an adult shell consisting of pairs of narrow ribs linked at small ventral tubercles, in turn linked across the venter by a pair of looped ribs. Tubercles are lost on the last part of the shell, although the ribs remain associated in pairs. This specimen is significantly older than other, well-dated tuberculate pachydiscid microconchs, co-occurring with *Nowakites pailletteanus*.

Occurrence : Upper Coniacian *margae* Zone, Col du Linas.

Genus and subgenus *Pachydiscus* Zittel, 1884
(= *Parapachydiscus* Hyatt, 1900 : p. 570; *Joaquinites* Anderson, 1958 : p. 218; *Pseudomenuites* Matsumoto, 1955 : p. 169).

Type species : *Ammonites neubergicus* Hauer, 1858 (p. 12, pl. 2, fig. 1-3; pl. 3, fig. 1, 2, by the subsequent designation of de Grossouvre, 1894 (p. 177)).

Pachydiscus (*Pachydiscus*) *cayeuxi* de Grossouvre, 1894
Pl. 11, fig. 9-11

1894. *Pachydiscus cayeuxi* de Grossouvre (p. 191, pl. 36, fig. 3).
1925. *Pachydiscus* cf. *cayeuxi* Grossouvre; Diener (p. 105).
1938. *Parapachydiscus cayeuxi* (de Gross.); Collignon (p. 33, pl. 4, fig. 5).
? 1952. *Pachydiscus* cf. *cayeuxi* de Grossouvre; Collignon (p. 69).
1952. *Pachydiscus cayeuxi* (de Gross.); Collignon (p. 89).
? 1952. *Pachydiscus* cf. *cayeuxi* de Grossouvre; Collignon (p. 67).
1955. *Pachydiscus cayeuxi* (de Gross.); Collignon (p. 81).
1983. *Pachydiscus cayeuxi* de Grossouvre; Collignon (p. 194).

Type : Holotype, by monotypy, is MNHP R51867, the original of de Grossouvre (1894 : pl. 36, fig. 3), from the 'Marnes ferrugineuses intercalées entre les bancs inférieurs de rudistes sur le chemin de Sougraigne aux Croutets (Aude). Niveau à *Placenticeras syrtale*' (de Grossouvre, 1894 : p. 192).

Dimensions :	*D*	*Wb*	*Wh*	*Wb*:*Wh*	*U*
Holotype	53.0	28.5	25.5	1.1	13.0
MNHP 51867, at	(100)	(53.8)	(48.1)		(24.5)

Description : The holotype is the only specimen known from the Corbières. it seems to be a small adult, well-preserved and undeformed to a diameter of 53 mm; the maximum preserved diameter is 78.5 mm. Coiling is involute, with 73 % of the previous whorl covered, the umbilicus small, deep, with broadly rounded umbilical wall and shoulder. The whorl section is depressed reniform with broadly rounded flanks and a whorl breadth-to-height ratio of 1.1; the ventrolateral shoulders and venter are broadly and evenly rounded. At a diameter of 50 mm there are eight to nine umbilical bullae per whorl, initially subspinose, but weakening markedly as size increases. They give rise to one or two narrow, weak, distant ribs that are straight and prorsiradiate on the flanks and sweep forwards over the ventrolateral shoulders, strengthen slightly and cross the venter in a feeble convexity. There are one or two long or short narrow, intercalated ribs that strengthen across the flanks to match and parallel the primary ribs on ventrolateral shoulders and venter. Beyond 50 mm diameter the ribs crowd markedly, are closely spaced, narrow, prorsiradiate, feebly concave across the flanks, flexed forwards across the ventrolateral shoulder and broadly convex across the venter. Bullate primaries are separated by up to five predominantly long, secondary ribs at the adapical end of the body-chamber, the number decreasing as size increases. In middle growth there is a marked tendency for ribs to show variable spacing, closely spaced pairs being associated with shallow, widely spaced constrictions. This feature is not shown below a diameter of 50 mm, and is ill defined on the body-chamber.

Discussion : The curious pairing of ribs in middle growth and associated constrictions, plus very fine ribbing at (?) maturity serve to distinguish this species from *Eupachydiscus isculensis* juveniles (e.g. Pl. 11, fig. 1-3). Sparsely ribbed, early growth stages and constrictions distinguish it from *P.* (*P.*) *jeani* de Grossouvre, 1894 (p. 187, pl. 26, fig. 1), (see below and Pl. 12, fig. 1-6).

Occurrence : As for type; also recorded from the presumed Santonian of Ankomaka, Madagascar.

Pachydiscus (*Pachydiscus*) *jeani* de Grossouvre, 1894
Pl. 12, fig. 1-6

1894. *Pachydiscus jeani* de Grossouvre (p. 187, pl. 26, fig. 5).
1922. *Eupachydiscus jeani* (Grossouvre); Spath (p. 124).
1925. *Eupachydiscus jeani* Grossouvre; Diener (p. 111).
1952. *Eupachydiscus jeani* Grossouvre; Collignon (p. 56).
1955. *Eupachydiscus jeani* Grossouvre; Collignon (p. 56).
1983. *Eupachydiscus jeani* Grossouvre; Collignon (p. 79).

Type : The holotype, by monotypy, is the original of de Grossouvre, 1894 (p. 187, pl. 26, fig. 6), in the collection of Joseph Jean, and from 'des marnes ferrugineuses à *Placenticeras syrtale* des

environs de Sougraignes, intercalées entre les bancs inférieurs de rudistes'. We have been unable to trace this specimen.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP, ex Toucas Coll.	104.0 (100)	42.0 (40.8)	48.5 (46.6)	0.86	18.7 (18.0)

Description : We have seen two specimens (SP unregistered, ex Toucas Collection). The smaller (Pl. 12, fig. 1-3) is labelled 'Moulin Tiffou' and is 104 mm diameter, wholly septate, slightly distorted, with traces of aragonitic shell preserved. Coiling is relatively involute, with 74 % of the previous whorl covered, the umbilicus comprising 18 % of the diameter, quite deep, with a flattened wall and rounded shoulder. The original whorl section has been modified by crushing but appears to have been compressed, with a whorl breadth-to-height ratio of 0.9, the inner flanks feebly inflated, the outer flanks flattened and convergent, the ventrolateral shoulders and venter broadly and evenly rounded. To a diameter of 70 mm ornament is of distant, feebly bullate primary ribs, five per half whorl, that give rise to from one to three delicate, narrow ribs, with additional long and short ribs intercalated to give a total of 36-38 ribs per half whorl. The ribs are straight on the inner to mid flank, but flex forward and are feebly concave and strengthened on the outermost flank and ventolateral shoulder, to pass across the venter in a very feeble convexity. Beyond 70 mm the ornament changes markedly, to coarse, widely separated primary and secondary ribs in approximately equal numbers. On the first half whorl exposed, occasional ventrolateral and ventral ribs are strengthened into collars to feeble constrictions, approximately four per half whorl, and conspicuous only on outer flanks and venter.

The second Toucas specimen, labelled 'Sougraigne' is a crushed adult 145 mm in diameter (Pl. 12, fig. 4-6), and has 120° approximately of body chamber preserved, with 10 coarse, bullate primary ribs, concave on the umbilical shoulder, and prorsiradiate and concave across the flanks, where occasional short, intercalated ribs are developed.

Discussion : The very finely and closely ribbed inner whorls, with feeble constrictions, are reminiscent of *Nowakites*, the outer whorl and body chamber like those of *Pachydiscus* (*Pachydiscus*), a combination distinguishing the species from others known from the Corbières. The illustrated specimens and a third individual (SP, ex Toucas Collection, unregistered) show the same ontogenetic changes as the holotype, but a marked concavity of innermost flank ornament.

Occurrence : Upper Santonian *paraplanum* Subzone of the Corbières.

Genus *Eupachydiscus* Spath, 1922
(= *Mesopachydiscus* Yabe & Shimizu, 1926 : p. 172)

Type species : *Ammonites isculensis* Redtenbacher, 1873 (p. 122, pl. 29, fig. 1, by original designation by SPATH, 1922 (p. 124)).

Discussion : The type species of *Eupachydiscus* is based on a macroconch. Immel *et al.* (1982) have recently described, as *Pseudomenuites katschthaleri* (p. 20, pl. 7, fig. 2-5), a small bituberculate form that may be the microconch of the type species. *Pseudomenuites* Matsumoto, 1955 (p. 169) has Pachydiscus ambiguus de Grossouvre, 1894 as type species; this is a microconch *Pachydiscus* (*Pachydiscus*) (Kennedy, 1986a).

Eupachydiscus isculensis (Redtenbacher, 1873)
Pl. 9, fig. 9, 10; Pl. 10, fig. 12; Pl. 11, fig. 1-3, 5-8; Fig. 18, 19

1873. *Ammonites isculensis* Redtenbacher (p. 122, pl. 29, fig. 1).
1894. *Pachydiscus isculensis* Redtenbacher sp.; de Grossouvre (p. 185, pl. 22, fig. 2; pl. 26, fig. 1; pl. 37, fig. 1).
? 1898. *Pachydiscus isculensis* Redtenbacher sp.; Mariani (p. 55; text-fig. on p. 56).
1906. *Pachydiscus isculensis* Redtenbacher; Muller & Wollemann (p. 9, pl. 7, fig. 1, 2; text-fig 1, 2).
1922. *Eupachydiscus isculensis* (Redtenbacher); Spath (p. 124).
1925. *Eupachydiscus isculensis* (Redtenbacher); Diener (p. 110).
1931. *Pachydiscus isculensis* (Redtenbacher); Basse (p. 34).
1932. *Pachydiscus isculensis* (Redtenbacher); Collignon (p. 51, pl. 3, fig. 4; text-fig. 5).
1935. *Pachydiscus isculensis* (Redtenbacher); Brinkmann (p. 4).
? 1938. *Eupachydiscus isculensis* (Redtenbacher); Dietrich (p. 228, ff).
? 1938. *Eupachydiscus isculensis* (Redtenbacher); Collignon (p. 27).
1950. *Eupachydiscus isculensis* (Redtenbacher); Hourcq (p. 72, 78).
1952. *Eupachydiscus isculensis* Redt.; Collignon (p. 31, pl. 4, pl. 6, fig. 1).
1955. *Eupachydiscus isculensis* Redt.; Collignon (p. 32, pl. 4, fig. 1; pl. 6, fig. 1; text-fig. 4).
1957. *Eupachydiscus isculensis* (Redtenbacher); Wright (p. 380, fig. 495, 2).
1961. *Eupachydiscus isculensis* (Redtenbacher); Gerth (p. 124, pl. 24, fig. 7).
1966. *Eupachydiscus isculensis* (Redtenbacher); Collignon (? p. 36, pl. 470, fig. 1918; ? pl. 471, fig. 1918; p. 90, pl. 492, fig. 1977).
1979. *Eupachydiscus isculensis* (Redtenbacher); Wiedmann *in* Herm *et al.* (p. 49, pl. 8A).
1979. *Eupachydiscus isculensis* (Redtenbacher); Summesberger (p. 136, pl. 7, fig. 30, 31; pl. 8, fig. 32; text-fig. 20, 21, 22).
1982. *Eupachydiscus isculensis* (Redtenbacher); Martinez (p. 83, pl. 7, fig. 3).
1982. *Eupachydiscus isculensis* (Redtenbacher); Tzankov (p. 39, pl. 17, fig. 3; pl. 18, fig. 2, 3).
? 1982. *Pseudomenuites katschhaleri* Immel *et al.* (p. 20, fig. 2-5 (with synonymy))
1982. *Eupachydiscus isculensis* (Redtenbacher, 1873); Immel *et al.* (p. 22, pl. 7, fig. 8-11; pl. 8, fig. 1-4).
1983. *Eupachydiscus isculensis* (Redt.); Collignon (p. 194).
1986. *Eupachydiscus isculensis* (Redtenbacher, 1873); Kennedy (p. 5, pl. 2, fig. 5, 6; pl. 10, fig. 13, 14; text-fig. 19).
1988. *Eupachydiscus isculensis* (Redtenbacher), 1873; Thomel (p. 38, pl. 4, figs. 1, 2).
1992. *Eupachydiscus isculensis* (Redtenbacher, 1873); Santamaria Zabala (p. 222, pl. 1, fig. 5).

Holotype : By monotypy, an unregistered specimen in the Oberôsterreichisches Landesmuseum, Austria, from the Santonian Gosau Beds between Ischl and Kohlbuch, Austria, the original of Redtenbacher, 1873 (pl. 29, fig. 1) reillustrated here as Figure 18.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
MNHP R51862	54.2 (100)	– (–)	23.8 (43.9)	–	13.0 (24.0)
FSL14115	106.5 (100)	55.5 (52.1)	49.5 (46.5)	1.12	24.3 (22.8)

Description : The smallest of the well-preserved Corbières specimens is MNHP R51862, the original of de Grossouvre, 1894 (pl. 57, fig. 1) (Pl. 11, fig. 1-3). Coiling is moderately involute, with a deep umbilicus comprising 24 % of the diameter. The umbilical wall and shoulder are markedly convex; the whorl section is depressed and reniform. Nine variably developed umbilical bullae give rise to one or, rarely, two primary ribs, with up to three primary ribs without bullae between bullate ones. Additional ribs arise low on the flank to give a total of 36 ribs visible on the outer whorl (equivalent to an estimated total of 40 per whorl), of which around 21 extend or almost extend to the umbilical shoulder. The ribs are rectiradiate and feebly concave across the flanks, projecting forwards over the ventrolateral shoulder and crossing the venter in a broad convexity. The ribs are narrow, rather sharp, and separated by very wide interspaces.

FSL 14115 (ex EMP 1.40.1) continues the ontogeny to 105 mm diameter, and is the original of de Grossouvre, 1894 (pl. 26, fig. 1).

FIGURE 18

Eupachydiscus isculensis (REDTENBACHER, 1873).
The holotype, an unregistered specimen in the Oberösterreichs Landesmuseum, Austria, from the Santonian Gosau Beds between Ischl and Kohlbuch, Austria, the original of REDTENBACHER, 1873 (pl. 27, fig. 1). Reduced x 0.75.

The label reads : 'couches marneuses intercalées entre les bancs inférieurs à Rudistes du chemin de Sougraigne aux Croutets'. The specimen is an internal mould, septate to 91 mm diameter. Coiling is involute, the deep umbilicus comprising 22.8 % of the diameter, the whorl section depressed reniform with the greatest breadth low on the flanks and a whorl breadth-to-height ratio of 1.12. Ornament on the first half of the outer whorl is much as in the juvenile described above, but on the last half whorl, ribbing coarsens markedly and consists of sharp, narrow, distant, alternately long and short ribs (Fig. 19). This trend continues in PM A8-8, a body-chamber fragment with a maximum preserved diameter of 140 mm and 14 alternately long and short ribs on the last half whorl. This specimen and others from the Corbières have fewer ribs than the holotype; yet others have a comparable rib density. The holotype itself (Fig. 18) is a magnificent adult specimen with just over half a whorl of body-chamber, retaining extensive traces of the original aragonitic shell. It is somewhat crushed, and deformed into an ellipse with major dimension of 190 mm. Coiling is moderately involute, with approximately 70 % of the previous whorl covered. The umbilicus is deep and narrow (approximately 20-25 % of the diameter), with a high, outward-inclined wall. The whorl section appears to have originally been depressed, with an abruptly rounded umbilical shoulder, rounded, convergent flanks and rounded venter, the greatest breadth being at the umbilical shoulder.

At the smallest diameters visible, about 12 strong ribs arise on the umbilical wall, and develop into strong bullae at the umbilical shoulder, which in turn give rise to coarse, prorsiradiate primary ribs. On the outer whorl, there are 17 primary ribs which arise on the umbilical wall, and develop into strong bullae at the umbilical shoulder, which in turn give rise to coarse, prorsiradiate primary flank ribs. On the outer whorl, there are 17 primary ribs which arise at the umbilical seam and pass back across the umbilical wall, strengthening as they do so, and developing into massive umbilical bullae on the umbilical shoulder. At the beginning of the outer whorl, strong ribs arise in groups of two or three from these bullae, but as size increases, the ribs become single, strong and prorsiradiate, straight on the inner flank but concave across the middle and outer flank, whence they sweep across the venter. Secondary ribs intercalate at various positions on the flank, with generally one or two between the pairs of primary ribs, so that there is a total of 42-43 ribs on the outer whorl. At the aperture, the ribs decline markedly after a final strong bullate primary.

FIGURE 19

Eupachydiscus isculensis (REDTENBACHER, 1873).
FSL 14115, *ex* EMP Collections, the original of de GROSSOUVRE, 1894 (pl. 26, fig. 1) from the 'couches marneuses intercalées entre les bancs inférieurs à rudistes du chemin de Sougraigne aux Croutets (Aude)'.

Discussion : SUMMESBERGER (1979) and IMMEL *et al.* (1982) recently described a series of well-preserved specimens of *Eupachydiscus isculensis* from the Santonian of the Gosau Group, Austria. The latter figure, as *Pseudomenuites katschthaleri* IMMEL, KLINGER & WIEDMANN, 1982 (p. 20, pl. 7, fig. 2-5) a small form which has early whorls like those of *isculensis* but with ventral tubercles on the body-chamber linking pairs of flank ribs which thus loop between these and the umbilical bullae. Bituberculate pachydiscids are in some cases demonstrably microconchs, and I take this to be the case with *katschthaleri vs. isculensis*.

Eupachydiscus grossouvrei (KOSSMAT, 1898) (p. 101 (166)) = *Ammonites Ootacodensis* STOLICZKA, 1865 (p. 109, pl. 57), is a Middle Campanian species, easily distinguished by its much more delicate ornament with more numerous intercalatories, as is *E. pseudogrossouvrei* COLLIGNON, 1952 (p. 42, pl. 8, fig. 1, 2; 1955, p. 42, pl. 8, fig. 1, 2) from the Middle Campanian of Madagascar. *E. haradai* (JIMBO, 1894) (p. 29, pl. 2, fig. 2; see USHER, 1952 : p. 73, pl. 12, fig. 2-4; pl. 13, fig. 1-3; pl. 31, fig. 6) is densely ribbed with weak bullae. *Pachydiscus (Pachydiscus) jeani* (de GROSSOUVRE, 1894) (p. 187, pl. 26, fig. 5), from the Santonian of Aude, France (see above), is a curious species : the inner whorl bears fine, dense, crowded straight ribs without bullae, and the ribs coarsen abruptly on the later parts of the outer whorl, but without the prominent bullae of *E. isculensis*. In *Pachydiscus launayi* de Grossouvre, 1894, a Campanian species referred to *Eupachydiscus* by some authors, ribbing is finer, denser, and without bullae. *E. sayni* (de GROSSOUVRE, 1894) (p. 181, pl. 29, fig. 2) may be similarly distinguished. Other species, listed by COLLIGNON (1952 : p. 86; 1955 : p. 79) may also be easily separated from the present form.

Occurrence : *E. isculensis* ranges from Middle Santonian to Lower Campanian. In the Corbières it occurs in the *gallicus* and *paraplanum* Subzones. It is also known from Assise P^1 in northern Aquitaine. It is known from the Santonian of Germany, northern Spain, Austria, Romania, and Zululand (South Africa), and the Santonian and Campanian of Madagascar.

Unassigned pachydiscid microconch
Pl. 6, fig. 9, 10, 22, 23

Discussion : OUM KZ 20714 is a small, distorted pachydiscid microconch with diameter of 24.5 mm. Coiling appears to have been involute. The whorls are massive, with a possibly depressed reniform whorl section. Ornament is of delicate prorsiradiate lirae and striae, with at least one pair of delicate ventral tubercles. It is impossible to link this specimen with any larger macroconch described from the Corbières, nor determine whether it is adult or juvenile.

Occurrence : Moulin d'Amont, east of Sougraigne. Upper Coniacian or Lower Santonian.

Genus *Hoepenites* COLLIGNON, 1952

Type species : *Pachydiscus patagonicus* PAULCKE, 1907 (p. 232, pl. 19, fig. 1, by original designation by COLLIGNON, 1952 : p. 9).

Hoepenites cf. *antecursor* (Van Hoepen, 1921)
Pl. 19, fig. 8, 9

compare :
1921. *Pachydiscus antecursor* Van Hoepen (p. 24, pl. 5, fig. 1, 2; text-fig. 13).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP unregistered	66.5 (100)	27.5 (41.4)	26.0 (39.1)	1.06	212.2 (~ 18.3)

Description : Unregistered specimens in the Sorbonne Collections (ex Toucas Collection) are up to 66.5 mm in diameter. Coiling is fairly evolute, the whorls slowly expanding, the shell serpenticone, with a whorl breadth-to-height ratio of 1.06. The umbilicus comprises 18.3 % of the diameter, and is of moderate depth, with a broadly rounded umbilical wall and more narrowly rounded umbilical shoulder. There were an estimated 22 ribs on the last half whorl; long narrow primaries, lacking bullae, and long and short intercalated ribs. All ribs are weak and narrow and separated by wide interspaces. They are straight and prorsiradiate on the inner and middle flank, and project slightly forwards over the ventrolateral shoulder, strengthen and cross the venter in a broad convexity. A faint groove marks the line of the siphuncle.

Discussion : Coiling and whorl proportions recall *Hoepenites* described from South Africa by Van Hoepen (1921) and Spath (1922), although the ribs of these species are a little more flexuous.

Occurrence : Santonian. Sougraigne.

Juvenile pachydiscids
Pl. 10, fig. 1-6, 9-11

Discussion : The pyritic faunas from the Santonian of the Corbières yield a small number of juvenile pachydiscids up to 13 mm in diameter, that we are unable to relate to taxa occurring as larger individuals in the same sequence. At least two forms are present. One (Pl. 10, fig. 1-6) has a depressed, reniform whorl section and is smooth, but for four strong, sinuous prorsiradiate constrictions per whorl, with incipient collar-ribs. The second (Pl. 10, fig. 9-11) has five strong, straight, prorsiradiate constrictions per whorl and five to six small, sharp umbilical bullae. It resembles to a degree '*Lewesiceras*' *boulei* (Collignon, 1931) (p. 17, pl. 3 fig. 1-4; p. 53, pl. 7, fig. 6)

Occurrence : Lower Santonian *carezi* Subzone, Les Clémencis, Corbières.

Family Muniericeratidae Wright, 1952
Genus *Muniericeras* de Grossouvre, 1894
(= *Praemuniericeras* Collignon, 1966 (p. 13); *Morrisites* Van Hoepen, 1968 (p. 185)).

Type species : *Muniericeras lapparenti* de Grossouvre, 1894 (p. 158, pl. 29, fig. 1, 5; pl. 35, fig. 3) by original designation by de Grossouvre, 1894 (p. 157).

Muniericeras lapparenti de Grossouvre, 1894
Pl. 13, fig. 11, 12, 15; Pl. 15, fig. 20

1894. *Muniericeras lapparenti* de Grossouvre (p. 198, pl. 29, fig. 1, 5; pl. 35, fig. 3).
1925. *Muniericeras lapparenti* de Grossouvre; Diener (p. 154).
1938. *Muniericeras lapparenti* de Grossouvre; Roman (p. 458, pl. 46, fig. 437, 437a).
1957. *Muniericeras lapparenti* de Grossouvre; Wright (p. L 381, fig. 498, 1).
1983. *Muniericeras lapparenti* de Grossouvre; Collignon (p. 196).

Types : Holotype by original designation, is the original of de Grossouvre, 1894 (pl. 29 fig. 1) (Pl. 13, fig. 11, 12), a specimen in the MNHP Collections, from the 'couches sénoniennes inférieures des environs de Bugarach (Aude)'. There are two paratypes. The original of de Grossouvre, 1894 (pl. 29, fig. 5), is no M949 in the Collections of the École des Mines, Paris, now housed in the Université Claude-Bernard, Lyon (Pl. 13, fig. 15), from the 'Calcaires à micrasters, côté droit du chemin de Rennes-les-Bains à Montferrand (Aude)'. The second paratype (de Grossouvre, 1894) (pl. 35, fig. 3) has not been traced.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
Holotype	64.0 (100)	14.8 (23.1)	25.5 (39.8)	0.58	16.5 (25.8)

Description : The holotype (Pl. 13, fig. 11, 12) is 64 mm in diameter. Coiling is moderately involute, the umbilicus comprising around 25.8 % of the diameter, shallow, with a low, rounded wall. The whorl section is compressed (whorl breadth-to-height ratio 0.58), with feebly convex inner, and convergent outer flanks and an acute venter. Five strong umbilical bullae give rise to groups of two or three ribs, with one or two non-bullate primaries between. The ribs are strong, prorsiradiate, crowded, falcoid, strengthened on the outer flank and sweeping forwards across the ventrolateral shoulders to produce a coarsely serrate venter. There are 20 ribs approximately on the last half whorl. The surviving paratype (Pl. 13, fig. 15) has a maximum preserved diameter of 65 mm. There are an estimated seven coarse umbilical bullae on the outer whorl giving rise to groups of two or three ribs, with one or two non-bullate primary ribs between, and occasional ribs branching to give a total of 17 ribs on the last half whorl.

Discussion : Specimens in the present collections include individuals that match closely with the holotype (e.g. Pl. 16, fig. 4, 5) as well as those that are much more coarsely ribbed and tuberculate, like the paratype (e.g. Pl. 16, fig. 6, 7). An adult of the feebly ribbed variant is shown as Plate 15, figure 20, where umbilical bullae weaken and disappear on the body-chamber.

Even the most coarsely ornamented individuals referred to *M lapparenti* have more numerous and persistent ribs than *Muniericeras bilottei* (Collignon, 1983), described below.

Occurrence : Santonian *carezi* and *gallicus* Subzones. Known only from the Corbières.

Muniericeras bilottei (Collignon, 1983)
Pl. 13, fig. 2, 4, 10; Pl. 14, fig. 2, 3, 10, 11; Pl. 17, fig. 1

1983. *Praemuniericeras bilottei* Collignon (p. 195, pl. 3, fig. 2-4).

Type : Holotype, by original designation, is UPST S16, the original of Collignon, 1983 (pl. 3, fig. 2) (Pl. 13, fig. 2) from the Middle Santonian Marnes Bleues de Sougraigne *gallicus* Subzone, 'route de Sougraigne aux Croutets'.

Description : Collignon based this species on the holotype (Pl. 13, fig. 2) and two small crushed individuals (1983 : pl. 3, fig. 3, 4) (Pl. 13, fig. 4, 10). We now have more than 30 specimens, preserved up to diameters of 100 mm; all are crushed to varying degrees. Coiling of phragmocones is moderately involute, the umbilicus comprising around 25 % of the diameter, with a low, flattened wall and narrowly rounded umbilical shoulder. The whorl section was compressed, with feebly convex inner flanks, flattened, convergent outer flanks and an acutely fastigiate venter. Ornament is variable but generally weak to moderate in strength. Small umbilical bullae, ten to 16 per whorl, perch on the umbilical shoulder and give rise to one or two low, broad, weak, straight prorsiradiate ribs that flex back across the mid-flank and are markedly concave on the outer flank, where they terminate in well developed small ventral clavi. A sharp siphonal keel is strengthened into high, sharp siphonal clavi, displaced adaperturally of the ventral clavi. Ribbing weakens markedly on the body chamber and the last half whorl of adult specimens, ribs and tubercles efface and ornament is dominated by falcoid growth lines and striae, the ventral keel sharp and entire.

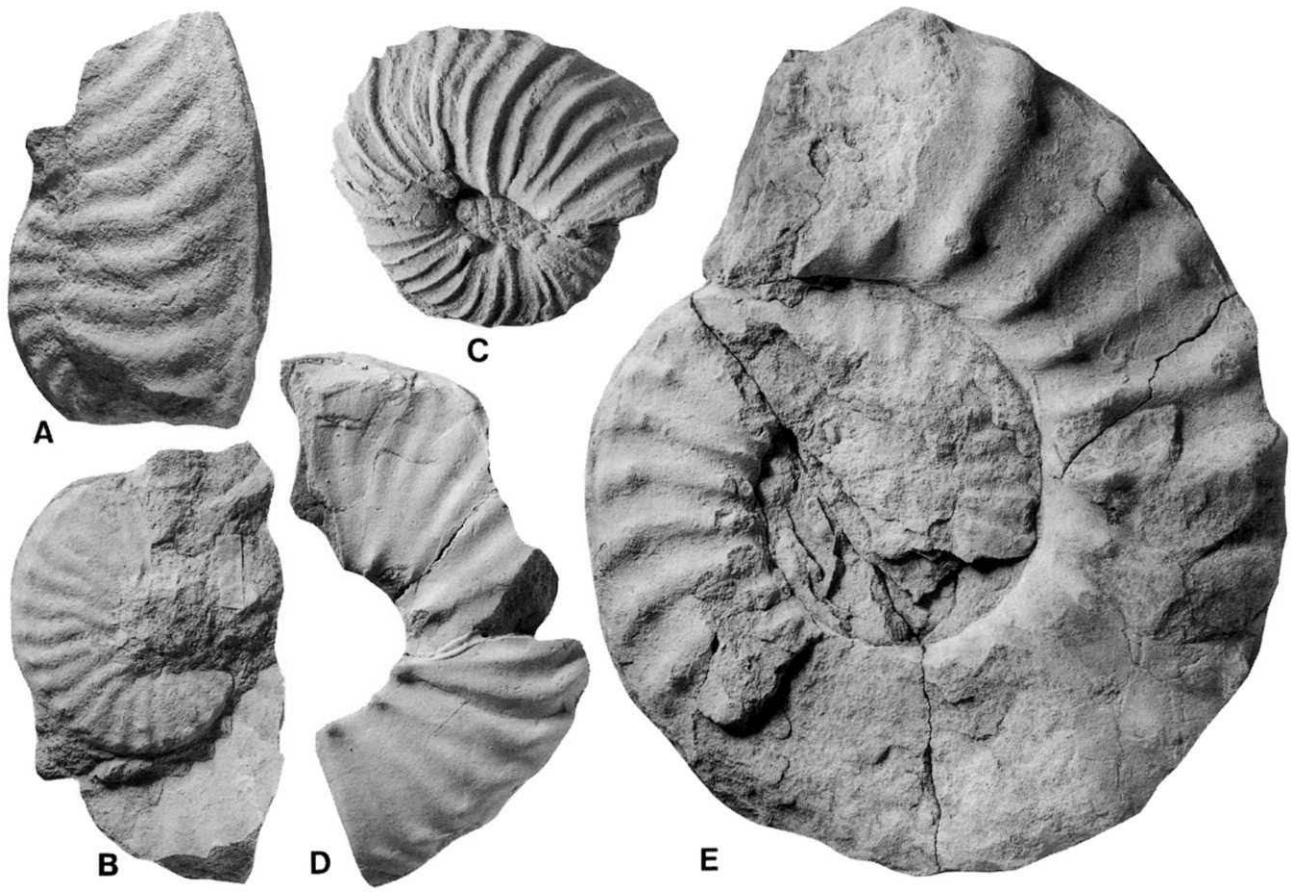

FIGURE 20

A, B, *Pseudobarroisiceras rennennse* (de GROSSOUVRE, 1894). PM 2028, Middle Coniacian *tridorsatum* Zone, Les Pastressis. C, *Nowakites savini* (de GROSSOUVRE, 1894), UPST 17, Middle Santonian *gallicus* Subzone, Sougraigne. D, *Pseudoschloenbachia* (*Pseudoschloenbachia*) *casterasi* COLLIGNON, 1983, PM B5-17, Middle Santonian *gallicus* Subzone, Ravin de la Coume. E, *Paratexanites zeilleri* (de GROSSOUVRE, 1894), Coniacian *tridorsatum* Zone, Soulatgè. All figures are × 1.

Discussion : *Muniericeras bilottei* is easily distinguished from other species known from the Corbières by its very weak ornament, delicate rather than coarse ribs and tubercles, and loss of ornament at maturity with a siphonal keel that is sharp and entire, rather than serrate. *Muniericeras gosauicum* (HAUER, 1858 : p. 13, pl. 2, fig. 7-9; GERTH, 1961 : p. 127, pl. 24, fig. 3) is a close ally, but appears to have weak tubercles combined with strong ribs. Its relationship to *M. bilottei* remains uncertain in the absence of adequate illustration and description of topotype material of the Austrian species.

Occurrence : Middle Santonian *gallicus* Subzone of the Corbières.

Genus *Texasia* REESIDE, 1932
(= *Lehmaniceras* COLLIGNON, 1966 (p. 50))

Type species : *Ammonites dentato-carinatus* ROEMER, 1852 (p. 33, pl. 1, fig. 2), by the subsequent designation of WRIGHT, 1957 (p. L. 432).

Texasia rivierae (COLLIGNON, 1983)
Pl. 13, fig. 1, 5, 6, 9, 13, 14; Pl. 18, fig. 13, 14

1983. *Praemuniericeras boriesi* COLLIGNON (p. 195, pl. 3, fig. 1).
1983. *Lehmaniceras rivierae* COLLIGNON (p. 197, pl. 3, fig. 7).

Name of the species : I regard *Praemuniericeras boriesi* COLLIGNON, 1983, and *Lehmaniceras riverae* COLLIGNON, 1983, as conspecific, and select *rivierae* as the name of the species.

Type : Holotype, by original designation is UPST RO2, the original of COLLIGNON, 1983 (pl. 3, fig. 7), from the Lower Santonian *carezi* Subzone, Marnes à *Micraster* of Claparayde, pont sur la Sals **(Pl. 13, fig. 13, 14).**

Description : We have more than 30 specimens, all composite moulds, and crushed to varying degrees, ranging up to 105 mm diameter. Coiling fairly evolute, umbilicus comprising around 25 % of diameter, of moderate depth with *a* flattened wall and broadly rounded umbilical shoulder. On the phragmocone eight to ten coarse umbilical bullae perch on the umbilical shoulder and give rise to pairs of coarse straight ribs, the adapical one recti– to feebly rursiradiate and weakly connected to the bulla, the adapertural one markedly prorsiradiate. All ribs bear coarse ventral clavi, connected by a feeble broad effaced rib to strong, high, adaperturally displaced siphonal clavi. Ribs decline but tubercles persist as size increases; the adapertural half of adult body-chambers show a rapid effacement of umbilical and ventrolateral tubercles, marked weakening of the siphonal row and development of crowded flexuous ribs, most obvious on the outer flank and ventrolateral shoulder (Pl. 13, fig. 5, 6).

Discussion : The type specimens of '*Lehmaniceras*' *rivierae* (Pl. 13, fig. 13, 14) and '*Praemuniericeras*' *boriesi* (Pl. 13, fig. 5, 6) are at first sight very different, but the early ornament of the latter

differs in no significant respects from that of the former, and the distinctive adapertural body chamber ornament of *boriesi* is associated with maturity, and can be matched in the new collections from the Corbières, where such adults co-occur with much larger individuals like the holotype.

Occurrence : Lower Santonian *carezi* Subzone of the Corbières.

Genus and subgenus *Pseudoschloenbachia* Spath, 1921

Type species : *Ammonites umbulazi* Baily, 1855 (p. 456, pl. 11, fig. 4) by original designation by Spath, 1921 (p. 236).

Pseudoschloenbachia (*Pseudoschloenbachia*) *inconstans* (de Grossouvre, 1894)
Pl. 14, fig. 7, 8, 12, 13; Pl. 15, fig. 1-6, 13-16; Pl. 16, fig. 3, 8, 9

1894. *Muniericeras inconstans* de Grossouvre (p. 159, pl. 35, fig. 4, 5).
1925. *Muniericeras inconstans* Grossouvre; Diener (p. 154).
1983. *Pseudoschloenbachia inconstans* (de Grossouvre); Collignon (p. 197, pl. 4, fig. 1-4, *non* 5).

Types : Lectotype here designated, is MNHP R5909, the original of de Grossouvre, 1894 (pl. 35, fig. 5) from the 'Calcaires marneux à la base des couches à micrasters, Ravin de Montferrand (Aude)' (Pl. 15, fig. 14, 15); paratype MNHP R52610 is from the same horizon and locality, and is the original of de Grossouvre, 1894 (pl. 35, fig. 4) (Pl. 15, fig. 16).

Description : We have more than 60 specimens, most of them crushed to varying degrees, and up to 63 mm in diameter. Coiling is involute, the umbilicus small, comprising around 18-20 % of the diameter, very shallow, with a low wall and very narrowly rounded umbilical shoulder. The whorl section is very compressed, lanceolate, with inner flanks flattened to feebly concave, outer flanks and ventrolateral region convex and venter acute with a sharp, entire siphonal keel. Ornament is variable between individuals. The lectotype (Pl. 15, fig. 14, 15) is 25.5 mm in diameter with ornament only partially preserved, but consisting of prorsiradiate straight ribs that arise either singly or in pairs from the umbilical shoulder, flex back across the mid-flank and are markedly concave on the outer flank and ventrolateral shoulder, where they may increase by branching or intercalation. The paralectotype (Pl. 16, fig. 6) is 32 mm in diameter, and has much weaker, near-effaced inner-flank ornament, with a markedly falcate course. Other individuals may show a near-smooth, feebly concave inner-flank zone (Pl. 15, fig. 3; Pl. 16, fig. 3, 9); yet others develop incipient bullae (Pl. 16, fig. 8). Adult body chambers (Pl. 14, fig. 12, 13; Pl. 15, fig. 13) show a progressive decline in ribs and their replacement by delicate crowded growth lines and striae. Well-preserved complete juveniles have up to 50 fine ribs per whorl (Pl. 16, fig. 3).

Discussion : This rather variable species is superficially similar to a number of other muniericeratids and collignoniceratids in the Corbières faunas but can be recognized on the basis of the absence or only incipient development of umbilical bullae, concave, feebly to unornamented inner-flank zone in many specimens, markedly falcate branching and intercalated ribs, lack of ventrolateral tuberculation and sharp, entire siphonal keel. One of the specimens referred to the species by Collignon (1983 : pl. 4, fig. 5) (see Pl. 15, fig. 1, 2) has a markedly serrate siphonal keel and strong umbilical bullae and is a *Muniericeras*. *Pseudoschloenbachia* (*Pseudoschloenbachia*) *bertrandi* (de Grossouvre, 1894 : p. 114, pl. 38, fig. 1) has coarse umbilical bullae, ribs, and ventrolateral tubercles.

Occurrence : Lower and Middle Santonian, *carezi* and *gallicus* Subzones of the Corbières.

Pseudoschloenbachia (*Pseudoschloenbachia*) *bertrandi* (de Grossouvre, 1894)
Pl. 14, fig. 1, 4, 5, 17; Pl. 18, fig. 6

1894. *Schloenbachia bertrandi* de Grossouvre (p. 114 (*pars*), pl. 38, fig. 1 only, *non* pl. 29, fig. 6).
1925. *Schloenbachia bertrandi* de Grossouvre; Diener (p. 133).
1983. *Pseudoschloenbachia bertrandi* (de Grossouvre); Collignon (p. 198 (*pars*), pl. 2, fig. 5, *non* pl. 4, fig. 8 (= *P.* (*P.*) group of *umbulazi*)).

Type : Holotype, by original designation, is MNHP R52614 (Pl. 14, fig. 17) the original of de Grossouvre, 1894 (pl. 38, fig. 1) from the 'Marnes bleues du ravin situé au nord de Sougraigne (Aude)'. The second specimen illustrated by de Grossouvre as belonging to this species (1894 : pl. 29, fig. 6) (Pl. 15, fig. 8, 19) is referred to *P.* (*P.*) *grossouvrei* sp. nov.

Description : The holotype (Pl. 14, fig. 17) is a crushed and distorted, possibly adult specimen 99 mm in diameter. The umbilicus comprises 30 % of the diameter and is shallow with a low, subvertical umbilical wall and narrowly rounded umbilical shoulder. The inner whorls are partially visible, showing part of the ornament, with nine strong spinose umbilical bullae per whorl that give rise to pairs of coarse ribs. The umbilical bullae are strong and subspinose on the first half of the outer whorl but weaker thereafter, totalling 13-14 per whorl. They give rise to low, broad, prorsiradiate ribs that may be single, or arise in pairs. These primary ribs are feebly flexed and prorsiradiate. Shorter intercalated ribs alternate regularly with the primaries, and arise at or around mid-flank, sometimes extending to the umbilical shoulder as mere striae. All bear strong spirally elongated ventral clavi. The venter is fastigiate on the mould, but there are clear traces of a sharp, high siphonal keel. The ribs extend forwards from the ventrolateral clavi to meet the keel at an acute angle; they are separated by deep interspaces. The strength of ribs and tubercles declines over the last 90° sector of the outer whorl, suggesting the specimen to be a near-complete adult. The early whorls are represented by a series of newly collected specimens (Pl. 14, fig. 1, 4, 5). The smallest of these PM G6-12 (Pl. 14, fig. 5) is 24.5 mm in diameter, and has only six massive subspinose umbilical tubercles per whorl and around twice that number of ribs and ventral clavi. PM G6-10 is a crushed individual 30 mm in diameter, with seven bullae (Pl. 14, fig. 4). PM K6-1 (Pl. 14, fig. 1) is distorted into an ellipse with a maximum diameter of 45.5 mm, has eight strong umbilical tubercles, and just over twice that number of ribs and ventral clavi.

Discussion : The remarkably coarsely and sparsely ribbed and tuberculate early whorls of the holotype and newly collected juveniles immediately distinguish *Pseudoschloenbachia* (*P.*) *bertrandi* from all other members of the genus of comparable size in the Corbières fauna. The paratype (Pl. 15, fig. 8, 19) has much weaker bullae, ribs and ventral tubercles, and represents a further *Pseudoschloenbachia* species, *P.* (*P.*). *grossouvrei* sp. nov. The larger specimen referred to *bertrandi* by Collignon (1983 : pl. 2, fig. 5) has a damaged venter (Pl. 18, fig. 6).

Occurrence : Middle and lower Upper Santonian, *gallicus* Subzone and lower part of *paraplanum* Subzone of the Corbières.

Pseudoschloenbachia (*Pseudoschloenbachia*) *casterasi* Collignon, 1983
Pl. 14, fig. 15, 16; Fig. 20D

1983. *Pseudoschoenbachia casterasi* Collignon (p. 198, pl. 4, fig. 9).
1992. *Pseudoschloenbachia* cf. *casterasi* Collignon, 1981; Santamaria Zabala (p. 224, pl. 2, fig. 1).

Type : Holotype, by original designation, is UPST MB 12PR (Pl. 14, fig. 15, 16), the original of Collignon, 1983 (p. 198, pl. 4, fig. 9) from the Lower Santonian *carezi* Subzone, Les Pastressis, ESE of Bugarach.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
UPST MB 12PR	72.5 (100)	13.1 (18.1)	127.0 (37.2)	0.49	20.5 (28.3)

Description : The holotype is a well-preserved composite mould of an adult showing little if any *post-mortem* distortion. Coiling is moderately evolute, becoming increasingly so around the last half whorl. The umbilicus is of moderate breadth, comprising 28.3 % of the diameter, shallow, with a low, flattened, umbilical wall and narrowly rounded umbilical shoulder.

The whorl section is very compressed (whorl breadth to height ratio 0.49), with the greatest breadth at the umbilical shoulder in intercostal section and at the umbilical bullae in costal section. The venter is fastigiate, with a sharp siphonal keel. There are an estimated 18 bullae perched on the umbilical shoulder, coarse on the phragmocone and adapical part of the body chamber, but weakening markedly on the adapertural part of the body chamber. On the phragmocone the bullae give rise to single ribs, with a shorter rib intercalated between and sometimes linked tenuously to the bullae. The ribs are feebly flexuous, straight on the inner flank but flexed back and feebly concave on the outer flank; they then sweep forwards to strong ventral clavi, whence they extend towards the siphonal keel as delicate riblets and striae. Ornament modifies progressively around the adult body-chamber, and on the adapertural part effaces markedly. A second specimen, PM B5-17 is a body-chamber the same diameter as the holotype, and showing the same progressive changes in ornament (Fig. 20D).

Discussion : Evolute coiling, coarse ribs and tubercles immediately distinguish this species from *P.* (*P.*) *inconstans* and *P.* (*P.*) group of *umbulazi*. *P.* (*P.*) *bertrandi* (de Grossouvre, 1894 : p. 114, pl. 38, fig. 1) (Pl. 14, fig. 17) has much more coarsely ornamented, paucicostate inner whorls, the outer whorls with weaker, distant ribs with markedly spirally elongated ventral clavi.

Occurrence : Lower and Middle Santonian, *carezi* and *gallicus* Subzones of the Corbières. Also recorded from the Santonian of Burgos and Alava, Spain.

Pseudoschloenbachia (*Pseudoschloenbachia*) *grossouvrei* sp. nov.
Pl. 15, fig. 7, 8, 19, pl. 19, fig. 1, 6

1894. *Schloenbachia bertrandi* de Grossouvre (p. 114 (*pars*), pl. 29, fig. 6).

Type : Holotype is the original of de Grossouvre, 1894 (pl. 29, fig. 6) (Pl. 15, fig. 8, 9), in the collections of the Muséum National d'Histoire Naturelle, Paris, from the 'Calcaire marneux jaune à *Lima marticensis*, situées immédiatement au-dessus des marnes bleues à *Mortoniceras texanum*, sur le chemin de Sougraigne aux Croutets (Aude)'.

Description : Coiling involute, umbilicus small (18 % of diameter), shallow, with flattened wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with feebly convex inner, and flattened, convergent outer flanks, the venter fastigiate, with a coarse siphonal keel. The whorl breadth-to-height ratio varies around 0.6. On phragmocone whorls coarse umbilical bullae, approximately ten per whorl, give rise to one, occasionally two straight, prorsiradiate coarse ribs, with short secondary ribs alternating regularly with the primaries to give a total of nine to ten ribs per half whorl at the ventrolateral shoulder, where they terminate in coarse, oblique, feebly clavate tubercles. These give rise to a weakening prorsiradiate rib that projects forwards across the ventrolateral shoulder. Rib separation increases markedly on late phragmocone and adult body-chamber; the largest specimen (PM A8-31), some 61 mm in diameter (Pl. 19, fig. 1) has only six narrow distant straight prorsiradiate primary ribs on the last half whorl, with no intercalated ribs, the ribs terminating in ventral clavi. Interspaces are ornamented by irregular weak riblets and striae which project strongly forwards across the ventrolateral shoulder and sometimes loop between umbilical and ventral tubercles.

Discussion : Outer and inner whorls of *Pseudoschloenbachia grossouvrei* are so different that I initially thought the latter to be some Santonian survivor of a *Prionocycloceras* stock, of which genus the species is a homoemorph (compare Renz, 1982 : pl. 35, fig. 11-13). It is easily distinguished from other *Pseudoschloenbachia* in the Corbières fauna by its coarse, distant ornament, straight, rather than flexuous ribs, and involute coiling.

Occurrence : Upper Santonian *paraplanum* Subzone of the Corbières.

Pseudoschloenbachia (*Pseudoschloenbachia*) group of *umbulazi* (Baily, 1855)
Pl. 13, fig. 7, 8; Pl. 14, fig. 6, 14; Pl. 22, fig. 6

compare :
1855. *Ammonites umbulazi* Baily (p. 456, pl. 11, fig. 4).

Discussion : A few *Pseudoschloenbachia* from the Corbières have coarse falcoid ribs and well-developed umbilical tubercles, features that set them apart from the majority of specimens referred to *P.* (*P.*) *inconstans* (compare Pl. 13, fig. 7, 8, and Pl. 16, fig. 3), resembling, rather the variable *P.* (*P.*) *umbulazi* group (e.g. Collignon, 1966 : pl. 499, fig. 1997-1999; pl. 500, fig. 2000-2002). Other specimens (Pl. 14, fig. 6, 14) have weak, irregular ribs combined with well-developed bullae.

Occurrence : Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones.

Superfamily Hoplitaceae H. Douvillé, 1890
(*nom. correct.* Wright & Wright, 1951 (p. 21)
(*pro* Hoplitida Spath,
nom. transl. ex Hoplitidae H. Douvillé, 1890 : p. 290)
Family Placenticeratidae Hyatt, 1900
(= Hypengonoceratinae Chiplonkar & Ghare 1976 (p. 2);
Baghiceratinae Chiplonkar & Ghare 1976 (p. 3)).
Genus *Placenticeras* Meek, 1876
(see Kennedy & Wright 1983a, p. 869 and Klinger & Kennedy 1989 (p. 266 for synonymy))

Type species : *Ammonites placenta* DeKay, 1828, by original designation by Meek, 1876 (p. 426).

Placenticeras polyopsis (Dujardin, 1837)
Pl. 17, fig. 2-7, 9, 10; Pl. 18, fig. 7-12; Fig. 21

1837. *Ammonites polyopsis* Dujardin (p. 232, pl. 17, fig. 12).
1983. *Placenticeras polyopsis* (Dujardin, 1837); Kennedy & Wright (p. 856, pl. 85-86, text-fig. 1-4 (with synonymy)).
1983. *Placenticeras syrtale* (Morton); Collignon (p. 200, pl. 6, fig. 1).
1983. *Stantonoceras guadaloupe* (Roemer) var. *quadrata* de Grossouvre; Collignon (p. 20, pl. 6, fig. 2).
1983. *Stantonoceras depressum* Hyatt; Collignon (p. 202, pl. 7, fig. 2).
1985. *Placenticeras polyopsis* (Dujardin); Kennedy (pl. 2, fig. 7-10).
1986. *Placenticeras polyopsis* (Dujardin, 1837); Kennedy (pl. 21, fig. 5-9).
1987. *Placenticeras polyopsis* (Dujardin, 1837); Kennedy (p. 768).
1992. *Placenticeras polyopsis* (Dujardin, 1837); Santamaria Zabala (p. 229, pl. 1, fig. 6, 7).
1994. *Placenticeras polyopsis* (Dujardin); Wiedmann (p. 238, pl. 43, fig. 10-12).

Lectotype : The original of Dujardin, 1837 (pl. 17, fig 12a), a juvenile macroconch from the 'Craie Tufau' of Touraine, France; designated by Kennedy & Wright 1983a (p. 856); present whereabouts unknown.

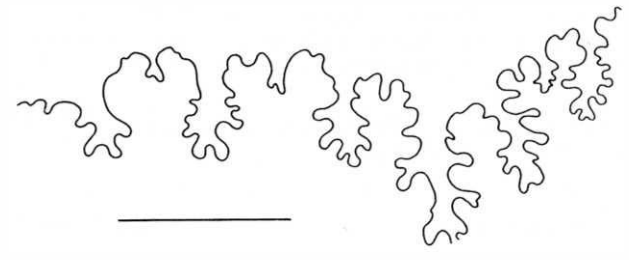

FIGURE 21

External suture of *Placenticeras polyopsis* (DUJARDIN, 1837). Sorbonne Collections, the original of de GROSSOUVRE, 1894 (pl. 7, fig. 1) (see also Pl. 18, fig. 11, 12) from the 'marnes ferrugineneses intercalées entre les bancs de rudistes sur le chemin de Sougraigne aux Croutets'. Bar scale is 10 mm.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP, de GROSSOUVRE 1894 (pl. 7, fig. 1).	120.0 (100)	38.5 (32.1)	51.5 (42.9)	0.75	28.5 (23.8)

Discussion : We have more than 50 specimens from the Corbières. Most are ill preserved, but the material ranges from pyritic nuclei (Pl. 7, fig. 9, 10; Pl. 18, fig. 7-10) to adults of both micro- and macroconch. The best-preserved adult is the original of de GROSSOUVRE, 1894 (pl. 7, fig. 1), from the 'Marnes ferrugineuses intercalées entre les bancs à rudistes sur le chemin de Sougraigne aux Croutets (Aude)' (Pl. 18, fig. 11, 12). This specimen (SP unregistered) is a syntype of HYATT's *Placenticeras depressum* and an adult microconch. It is a somewhat distorted mould, worn on one side, with a maximum preserved diameter of 140 mm approximately, the last 240° of the outer whorl body-chamber, the last few septa crowded, and the umbilical seam of the body chamber egressing markedly. There are 13-14 well-developed lateral tubercles on the outer whorl, and 24 ventrolaterals. The venter of the body-chamber is markedly flattened, with sharp ventrolateral ridges. The Corbières specimens referred to *Pseudoplacenticeras milleri* (VON HAUER) by COLLIGNON (1983 : p. 202, pl. 7, fig. 1) may be juveniles of this species. See KENNEDY & WRIGHT (1983a) for a full description and discussion of *P. polyopsis*.

Occurrence : In the Corbières, *P. polyopsis* ranges throughout most of the Santonian, from the upper part of the *carezi* Subzone to the *paraplanum* Subzone. Elsewhere in France the species appears to range throughout all of the Santonian of Aquitaine, from low in Assize M^1 to N^2 of ARNAUD. It is also known from the Santonian of Touraine and the Beausset Basin (Var). In Germany, WIEDMANN (1994) records it as being restricted to the Upper Santonian only, while in Spain he indicates a Lower and Middle Santonian occurrence. It occurs in the Upper Santonian of Austria.

A record from the Tombigbee Sand of Alabama (KENNEDY, 1986b) is an error based on *Placenticeras syrtale* (KENNEDY & COBBAN, 1991b). WIEDMANN (1994) records the species from England; we do not know the basis of this and believe it to be unfounded.

Placenticeras paraplanum WIEDMANN, 1978
Pl. 17, fig. 11, 12; Pl. 18, fig. 1-4

1978. *Placenticeras paraplanum* WIEDMANN (p. 666, pl. 1, fig. 3, 4; text-fig. 2a).
1979. *Placenticeras paraplanum* WIEDMANN; SUMMESBERGER (p. 152, pl. 13, fig. 53-57; text-fig. 38, 39).
1985. *Placenticeras* aff. *paraplanum* WIEDMANN; AMÉDRO & HANCOCK (p. 24 et. seq.; text-fig. 11a-c, f, g).
1986. *Placenticeras paraplanum* WIEDMANN, 1978; KENNEDY (p. 769, pl. 80, fig. 1-3, 8-10).

Holotype : By original designation is the original of WIEDMANN, 1978 (pl. 1, fig. 3, 4; text-fig. 2a) from the Upper Santonian Gosau Beds of the Gosau Basin, Austria.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP unreg., Pl. 18, fig. 1, 2	100.6 (100)	23.0 (22.9)	44.5 (44.2)	0.52 – (–)	

Description : The best-preserved specimen is a small ?adult in the SP collections, ex TOUCAS Collection, labelled '*Placenticeras syrtale*, MORTON, variètè *milleri*, HAUER, Marnes à *Lima marticensis* au-dessus du Banc à *Hipp. sublaevis*, Colline du Cimetière (Aude), Sougraigne', (Pl. 18, fig. 1, 2). Coiling is involute, with half a whorl of body-chamber preserved, the umbilical seam of which is markedly eccentric. The umbilicus is shallow, the umbilical wall flattened and inclined outward on the last half whorl, the umbilical shoulder narrowly rounded. The whorl section is compressed, with a whorl breadth-to-height ratio of 0.52, the greatest breadth low on the flank, the inner flanks broadly rounded, the outer flanks flattened and convergent, the ventrolateral shoulders narrowly rounded, the venter narrow and flattened. The flanks are ornamented by low, flat, inconspicuous ribs that anse at the umbilical seam, broaden and flex back on the outer flank, where shallow intercalated ribs may arise. The outer-flank ribs are convex, and terminate in long ventral clavi, 12 on the last half whorl, and opposite or slightly offset on either side of the venter. Interspaces may be constriction-like, while growth lines and striae, parallel to the ribs, become prominent on the adult body-chamber. Larger fragments referred to the species have whorl heights of up to 50 mm (Pl. 17, fig. 11, 12), lack flank ornament and have ventral clavi only.

Discussion : Convex course of flank ornament and presence of ventral clavi only distinguish this species from both *P. polyopsis*, described above, and *P. maherndli* SUMMESBERGER, 1979 (p. 155, pl. 14, fig. 58-61; pl. 15, fig. 62-66; text-fig. 40-47), which has narrow flexuous ribs on the body-chamber. The feebly ornamented *Placenticeras planum* HYATT of COLLIGNON (1983 : pl. 5, fig. 2) (Pl. 17, fig. 11, 12) may belong here: it resembles the Austrian specimen of SUMMESBERGER, 1979 (pl. 13, fig. 55).

Occurrence : Upper Santonian *paraplanum* Subzone in the Corbières. Elsewhere the species is known from the Upper Santonian of Aquitaine (KENNEDY 1987) and Austria.

Placenticeras maherndli SUMMESBERGER, 1979
Pl. 22, fig. 7

1979. *Placenticeras maherndli* SUMMESBERGER (p. 155, pl. 14, fig. 58-61; pl. 15, fig. 62-66; text-fig. 40-47).

Holotype : Specimen no 77/2 in the W.P. MAHERNDL Collection, Bad Ischel, Upper Austria, the original of SUMMESBERGER, 1979 (pl. 14, fig. 58, 59) from the Upper Santonian Sandkalkhank of the Gosau Basin, Austria.

Description : We have two specimens, UPST L13, 71 mm in diameter, labelled 'Couches de Sougraigne', and PM A8-32, a crushed individual 93 mm in diameter, from the Calcaire à *Lima marticensis* on the Chemin des Croutets. Coiling is very involute, the umbilicus small (around 18 % of diameter) with a flattened wall, inclined markedly outwards on the adult body-chamber, with a narrowly rounded umbilical shoulder. The whorl section is very compressed, with feebly convex inner flanks, flattened, convergent outer flanks, narrowly rounded ventrolateral shoulders and a narrow, tabulate venter. Our specimens show latest phragmocone and body-chamber ornament only : narrow, flexuous prorsiradiate ribs, sometimes arising in pairs from delicate umbilical bullae dominate flank ornament, with ventral clavi on adapertural phragmocone and the adapical end of the body-chamber, but thereafter lost, when the venter rounds.

Discussion : The narrow flexuous ribbing of latest phragmocone and body-chamber immediately distinguish *P. maherndli* from both *P. polyopsis* and *P. paraplanum*. See SUMMESBERGER (1979) for additional discussion.

Occurrence : Upper Santonian *paraplanum* Subzone in the Corbières. The species is otherwise known only from the Upper Santonian of the Gosau Basin, Austria.

Superfamily Acanthoceratacea de Grossouvre, 1894 (*nom. correct.* Wright & Wright, 1951 (p. 24) (*pro* Acanthoceratida Hyatt, 1900 (p. 585), *nom. transl.* ex Acanthoceratidae Hyatt, 1900 (p. 585), *nom. correct.* ex Acanthoceratidés de Grossouvre, 1894).

Family Pseudotissotiidae Hyatt, 1903
Genus *Hemitissotia* Peron, 1897
(= *Plesiotissotia* Peron, 1897 (p. 79); *Allotissotia* Parnes, 1964 (p. 14))

Type species : *Hemitissotia cazini* Peron, 1897 (p. 74, pl. 8(14), fig. 1-5; pl. 12(18), fig. 9, 10) by original designation by Peron, 1897 (p. 75).

Hemitissotia randoi Gerth, 1961
Pl. 14, fig. 9; Pl. 15, fig. 9

1961. *Hemitissotia randoi* Gerth (p. 131, pl. 24, fig. 1, 2).
1985. *Hemitissotia randoi* Gerth; Summesberger (p. 156).

Types : Lectotype, here designated, is the original of Gerth, 1961 (pl. 24, fig. 2), paralectotype is the original of his pl. 24, fig. 1, both from the Lower Santonian Gosau Beds of the Randograben, Austria.

Description : We have five specimens, all crushed composite moulds, ranging from 34.5-48 mm diameter. The shell is oxycone, with a markedly concave circumbilical zone occupying around 40 % of the flanks. Ornament is of distant, delicate, narrow, falcoid ribs, 12 per half whorl. These arise at the umbilical shoulder, often as mere striae, either singly or in pairs, and are feebly concave and feebly prorsiradiate on the inner flank but flex back and are markedly rursiradiate and concave on the outer flank. On early whorls they strengthen into incipient clavi on the outermost flank/ventrolateral shoulder. Some individuals retain more than half a whorl of body-chamber; ornament weakens markedly on the adapertural part, suggesting them to be adults of what must have been a very small species. The ill-preserved suture of PM K 3 S 3 has a little-incised E/L with plump elements, very narrow L, L/U_2 with only a single minor incision, the auxiliary elements entire.

Discussion : Ornament, shell shape and suture match those of the Austrian types, and distinguish the species from superficially similar oxycones in the Corbières Santonian faunas.

Occurrence : Lower and Middle Santonian, upper *carezi* and lower *gallicus* Subzones in the Corbières. The types are from the Lower Santonian Gosau Beds of Austria.

Family Collignoniceratidae Wright & Wright, 1951 (*nom. subst. pro* Prionotropidae Zittel, 1895 (p. 530))

Subfamily Barroisiceratinae Basse, 1947 (= Diaziceratinae Basse, 1947 (p. 159))
Genus *Forresteria* Reeside, 1932
(for synonymy see Kennedy *et al.*, 1983)

Type species : *Barroisiceras* (*Forresteria*) *forresteri* Reeside, 1932 (p. 17, pl. 5, fig. 2-7) by subsequent designation by Wright 1957 (p. L432) = *Acanthoceras* (*Prionotropis*) *alluaudi* Boule, Lemoine & Thévenin, 1907 (p. 12(32), pl. 1(8), fig. 6, 7).

Subgenus *Harleites* Reeside, 1932 (= *Alstadenites* Reeside, 1932 (p. 14); *Reesideoceras* Basse, 1947 (p. 132))

Type species : *Reesideoceras gallicum* Basse, 1947 (p. 133) = *Ammonites petrocoriensis* Coquand, 1859 (p. 995).

Forresteria (*Harleites*) *petrocoriensis* (Coquand, 1859)

1859. *Ammonites petrocoriensis* Coquand (p. 995).
1876. *Ammonites alstadenensis* Schlüter (p. 151, pl. 40, fig. 13-16).
1981. *Forresteria* (*Reesideoceras*) *petrocoriensis* (Coquand); Szász (p. 109, pl. 11, fig. 1-3).
1984a. *Forresteria* (*Harleites*) *petrocoriensis* (Coquand, 1859); Kennedy (p. 49, pl. 4, fig. 1, 2; pl. 5, fig. 1-11; pl. 6, fig. 1-9; pl. 7, fig. 1-20; pl. 9, fig. 1-4; pl. 21, fig. 2, 4; text-fig. 13d-f, h; 16; 18a, b, g (with full synonymy)).
1988. *Forresteria* (*Harleites*) *petrocoriensis* (Coquand); Szász & Ion (pl. 6, fig. 4).
1994. *Forresteria* (*Harleites petrocoriensis* (Coquand, 1859); Kaplan & Kennedy (p. 43, pl. 9, fig. 1-7).

Type : The holotype, by monotypy, is the original of *Ammonites petrocoriensis* Coquand, 1859 (p. 995), refigured by de Grossouvre, 1894 (pl. 2, fig. 5) and Kennedy 1984a (pl. 5, fig. 2-4). It is in the Collections of the École des Mines, Paris, now housed in the Université Claude-Bernard, Lyon.

Description : We only have two specimens of this important Lower Coniacian index species from the Corbières : PM PN V – VI, worn internal moulds of body-chambers with whorl heights of 40 mm. Coiling is involute, the umbilicus small, with a narrowly rounded umbilical shoulder. The whorl section is compressed, trapezoidal, with a whorl breadth-to-height ratio of 0.7 approximately. There are coarse umbilical bullae that give rise to blunt, straight, feebly prorsiradiate ribs that efface across the flanks. There are traces of blunt ventral clavi on either side of a flattened venter.

Discussion : Although poor, these specimens differ in no significant respects from those from Aquitaine figured by de Grossouvre (1894 : pl. 1, fig. 2, 3) and Kennedy (1984a : pl. 4, fig. 9; pl. 5, fig. 1, 11; pl. 6, fig. 10-12).

Occurrence : Lower Coniacian *petrocoriensis* Zone in the Corbières, Touraine and Aquitaine in France, the Münster Basin, Germany, Dover, England, Bohemia in the Czech Republic, and Romania.

Subfamily Collignoniceratinae Wright & Wright, 1951 (*nom. transl.* Wright, 1957 (p. L126) *ex* Collignoniceratidae; = Gauthiericeratinae Van Hoepen, 1955 (p. 367))

Genus *Gauthiericeras* de Grossouvre, 1894
(for synonymy see Klinger & Kennedy, 1984 (p. 238))

Type species : *Ammonites margae* Schlüter, 1867 (p. 29, pl. 5, fig. 2) by original designation by de Grossouvre, 1894 (p. 87).

Gauthiericeras margae (Schlüter, 1867)
Pl. 19, fig. 10, 11; Fig. 22

1867. *Ammonites margae* Schlüter (p. 29, pl. 5, fig. 2).
1982. *Gauthiericeras margae* (Schlüter); Martinez (p. 109, pl. 16, fig. 2-4).
1984a. *Gauthiericeras margae* (Schlüter, 1867); Kennedy (p. 88, pl. 18; pl. 20, fig. 3-4, 8-10; pl. 21, fig. 1, 5 : Pl. 22, fig. 13-17; text-fig. 27, 28, 29a, b; 30a, b; 31 (with full synonymy)).

1991a. *Gauthiericeras margae* (Schluter, 1867); Kennedy & Cobban (p. 41, pl. 6, fig. 5-7 (with additional synonymy)).
1992. *Gauthiericeras margae* (Schluter, 1867); Vasicek (p. 175, pl. 4, fig. 2, 3; text-fig. 7).
1994. *Gauthiericeras margae* (Schluter, 1867); Kaplan & Kennedy (p. 44, pls 10-13; pl. 14, fig. 1, 6, ?2, 3; pls 15-17; pl. 28, fig. 2).

Type : Holotype by monotypy is no. 25 in the collections of the Geologisches Institut of Bonn University, the onginal of Schluter 1867 (p. 29, pl. 5, fig. 2) from the Emscher-Mergel near Herne, Westphalia.

Description : *G. margae* is poorly represented in collections from the Corbières. OUM K217934 (Pl. 19, fig. 10, 11) is deformed into an ellipse with a major diameter of 68.5 mm, the maximum (deformed) whorl height 28 mm. Coiling is moderately evolute, with 40 % approximately of the previous whorl covered, the umbilicus comprising 29 % of the diameter. There are 11 umbilical bullae on the outer whorl, coarsening progressively as size increases. They give rise to single coarse primary ribs that alternate with short secondaries, all terminating in coarse outer ventrolateral clavi, to give a total of 21-22 ribs per whorl. The venter is fastigiate – unicarinate, with shallow grooves flanking the coarse siphonal keel. Much larger is PM RO 35 (Fig. 22) a very crushed composite mould 210 mm in diameter, with a maximum preserved whorl height of 88 mm, the outer whorl showing a progression from alternate primary and intercalated ribs to primary ribs only with very coarse ventrolateral tubercles and a coarse, obscurely serrated siphonal keel.

Discussion : The present material is crushed like the holotype, but otherwise resembles the large suite of undeformed specimens from St. Paterne-Racan (France) described by Kennedy (1984a : p. 88, pl. 18; pl. 20, fig. 3, 4, 8-10; pl. 21, fig. 1, 5; pl. 22, fig. 13-17; text-fig. 27, 28, 29A, B; 30A-B; 31) differing only in the absence of clear serrations on the ventral keel, possibly a reflection of the differing modes of preservation.

Ammonites stoppenbergensis Schlüter, 1872 (p. 46, pl. 13, fig. 7, 8), see also Schluter 1867 (pl. 6, fig. 5); Kaplan & Kennedy, 1994 (pl. 14, fig. 2, 3) is a *Gauthiericeras*, possibly a juvenile *G. margae*; the figured specimen is no 45 in the collections of the Geologisches und Paläontologisches Institut of Bonn University, from Stoppenberg, near Essen, Westphalia.

In Touraine, France *G. margae* occurs with a second species, G. *nouelianum* (d'Orbigny, 1850) (p. 212 (*pars*)); see below and revision in Kennedy 1984a (p. 96, pl. 19, fig. 1-3; pl. 20, fig. 1-7; pl. 22, fig. 18-19; text-fig. 29c, 30c, d). This is much more compressed and high-whorled, with crowded ribs. *Gauthiericeras? boreaui* (de Grossouvre, 1894) (p. 111, pl. 7, fig. 3); see revision in Kennedy 1984a (p. 102, pl. 21, fig. 3, pl. 22, fig. 1-12; text-fig. 39d-e) is a smaller compressed, involute, densely and flexuously ribbed species that lack ventrolateral tubercles (it may be better compared with *Pseudobarroisiceras* Shimizu, 1932). The South African *G. obesum* Van Hoepen, 1955 (p. 374; fig. 25-28); see revision in Klinger & Kennedy, 1984 (p. 243, fig. 97-114) have simple ribs and do not develop the lateral tuberculation of adult *G. margae*. Klinger & Kennedy (1984) discuss allied species. *G. roquei* Peron, 1897 (p. 52, pl. 2(8), fig. 1; pl. 3(9), fig. 1, 2; pl. 11(17), fig. 6); see revision in Kennedy & Cobban 1991a (p. 41, text-fig. 16) is a large species with only 10-11 coarse, distant ribs per whorl.

Occurrence : Where well-localized, *G. margae* characterises a well-defined, lower Upper Coniacian Zone. There are records from The Münster Basin in Germany, Austria, the Czech Republic, Touraine, Aquitaine, the Beausset Basin (Var), Alpes-Maritimes and Corbières in France, northern Spain, Romania, possibly North Africa, and Montana in the U.S. Western Interior.

Gauthiericeras nouelianum (d'Orbigny, 1850)
Pl. 15, fig. 17, 18; Pl. 20, fig. 6, pl. 21, fig. 2, 3, 8

1850. *Ammonites nouelianus* d'Orbigny (p. 212 (*pars*)).
1983. *Pseudoschloenbachia* (*Fournierella*) aff. *praefournieri* Collignon; Collignon (p. 199, pl. 5, fig. 1).
1984a. *Gauthiericeras nouelianum* (d'Orbigny, 1850); Kennedy (p. 96, pl. 19, fig. 1-13; pl. 20, fig. 1-7; pl. 22, fig. 18-19; text-fig. 29c, 30c, d (with full synonymy)).

Lectotype : MNHP d'Orbigny Collection no. 7189, figured by Kennedy, 1984a (pl. 19, fig. 11-13) from the Upper Coniacian *G. margae* Zone Calcaires Durs de La Ribochère of St. Paterne-Racan, Indre-et-Loire, France.

Discussion : Five juveniles 25-46 mm in diameter can be referred to this species, differing in no significant respects from topotypes of the same size. Larger is UPST S3 (Pl. 15, fig. 17, 18), described by Collignon (1983) as *Pseudoschloenbachia* (*Fournieriella*) aff. *praefournieri* Collignon, 1966. This specimen is a crushed and somewhat distorted phragmocone 66 mm in diameter, the coiling involute, with the umbilicus comprising only 15 % of the diameter, significantly less than that of the holotype, where the figure is 27.5 % at a diameter of 98.8 mm, but comparable to topotypes (e.g. Kennedy, 1984a : pl. 20, fig. 1, 2, where the figure is 20 %). There are 12 umbilical bullae that give rise to one or two ribs, with both long and short ribs intercalated, to give a total of 14 ribs at the ventrolateral shoulder on the last half whorl. The ribs strengthen markedly around the middle of the flanks and all terminate in a strong ventral clavus. Involution apart, the ornament of this specimen agrees well with that of topotypes of *G. nouelianum*, to which it is here referred.

Occurrence : Upper Coniacian *G. margae* Zone of Touraine and northern Aquitaine: Middle to lower Upper Coniacian, *tridorsatum* and *margae* Zones in the Corbières.

Genus *Pseudobarroisiceras* Shimizu, 1932

Type species : *Pseudobarroisiceras nagaoi* Shimizu, 1932 (p. 3, pl. 1, fig. 1, 2, 4-8) by original designation.

Pseudobarroisiceras rennense (de Grossouvre, 1894)
Pl. 15, fig. 10, 12; Pl. 16, fig. 1, 2, 11; Pl. 22, fig. 9; Fig. 20A, B

1894. *Muniericeras rennense* de Grossouvre (p. 160, pl. 35, fig. 2).
1925. *Muniericeras rennense* de Grossouvre; Diener (p. 154).
1983. *Pseudoschloenbachia rennensis* de Grossouvre; Collignon (p. 197 (*pars*), pl. 4, fig. 6, *non* 7 (= indeterminate muniericeratid)).

Type : Holotype, by monotypy, in an unregistered specimen is the MNHP Collections (Pl. 15, fig. 10), the original of de Grossouvre, 1894 (pl. 35, fig. 2) from the 'calcaires marneaux à la base des couches à *Micraster*, ravin de Montferrand' (Pl. 15, fig. 10, 11).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
PM R025	58.0 (100)	– (–)	28.2 (48.6)	–	11.4 (19.7)

Description : The best-preserved specimen is PM R025 (Pl. 16, fig. 1, 2) a juvenile 58 mm in diameter. Coiling is involute, the umbilicus comprising around 20 % of diameter, shallow, with a flattened, undercut wall and narrowly rounded shoulder. 11 small bullae perch on the shoulder, and project into the umbilicus. They give rise to groups of two or three ribs, with occasional intercalated ribs, to give a total of 20 ribs on the last half whorl. The ribs are low, broad and falcoid, straight on the inner flank but flexed back at mid-flank, concave on the outer flank and projected forwards to terminate in delicate ventral clavi. The venter is fastigiate, with a sharp siphonal keel, the clavi linked to the keel by delicate prorsiradiate growth lines and striae. A slightly larger specimen in the Sorbonne Collections (Pl. 15, fig. 12) is 69 mm in diameter and shows more markedly flexuous ribs and an excentric umbilical seam. The holotype (Pl. 15, fig. 10) is a worn, distorted fragment of a somewhat larger individual, 56 mm long, with a maximum preserved whorl height of 30.5 mm. There are traces of six umbilical

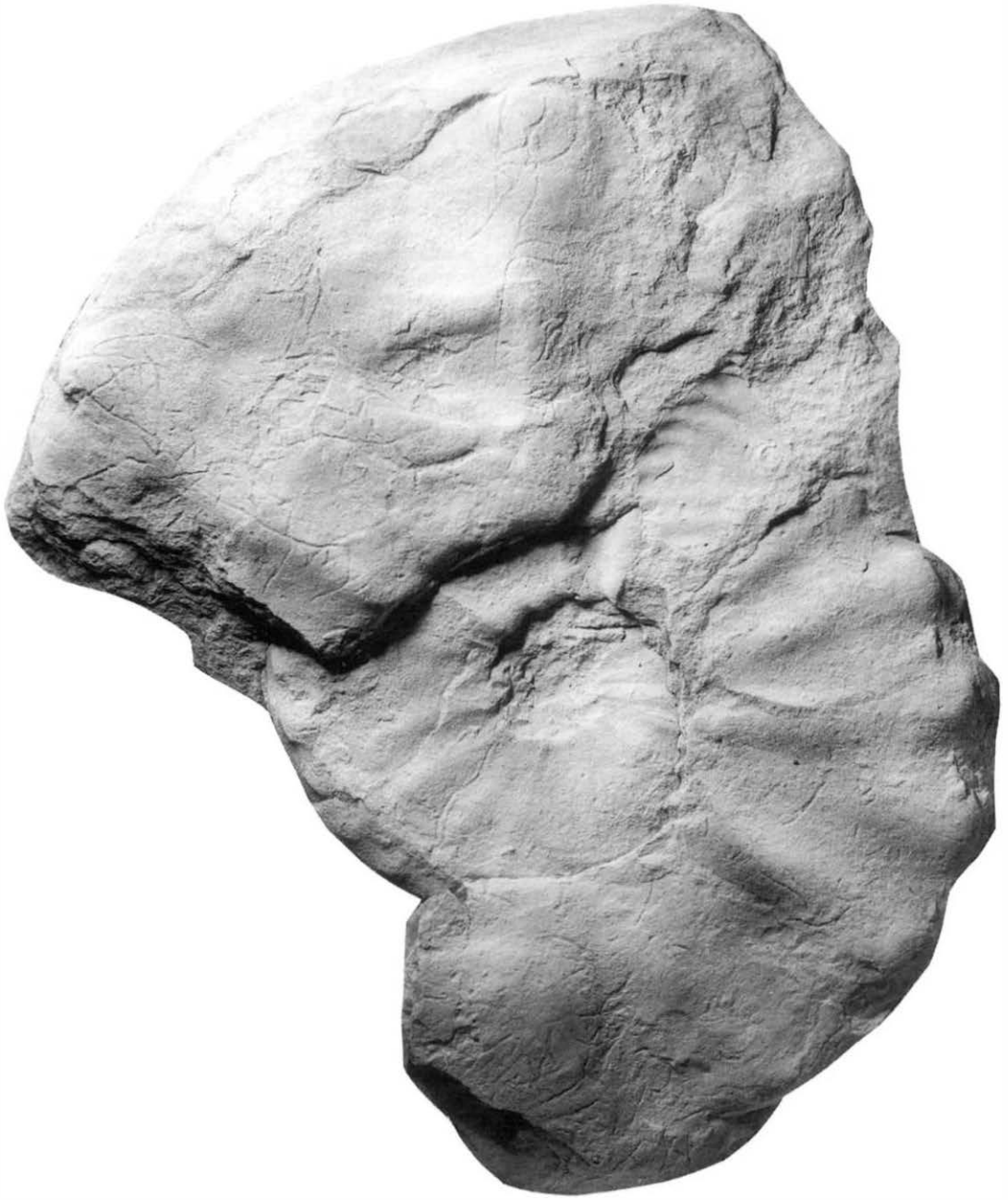

FIGURE 22
Gauthiericeras margae (SCHLUTER, 1867).
PM RO35, Upper Coniacian *margae* Zone, Les Pastressis. Figure is reduced × 0.8.

bullae and 13 ribs, arising in pairs from the bullae. Ribs terminate in progressively effacing ventral clavi. The venter is fastigiate, with a sharp, continuous keel. What appears to be an adult of the species is represented by PM R05, 110 mm in diameter (Pl. 16, fig. 11), the umbilicus comprising 25 % of the diameter. Ribs are less flexuous than in the previously described specimens, but ornament is of the same basic type. Ribs and tubercles decline markedly on the short section of shell preceding the adult aperture. None of the specimens show the suture.

Discussion : Ribbing, tubercles and presence of a continuous keel suggest the present species to be a *Pseudobarroisiceras*, given the Coniacian age. COLLIGNON (1983) referred *rennense* to *Pseudoschloenbachia* and assumed a Santonian age, even though de GROSSOUVRE described the species as coming from the base of the 'couches à Micraster' and thus Coniacian, an age and stratigraphic position confirmed here. MATSUMOTO (1970a) revised *Pseudobarroisiceras nagaoi* SHIMIZU, 1932 (p. 3, pl. 1, fig. 1, 2, 4-8); MATSUMOTO, 1970a (p. 306, pl. 48, fig 1; pl. 49, fig. 1; text-fig. 1-3),

which is a stouter species with coarser ribs, the tubercles bullate rather than clavate, the siphonal keel blunt. There are close similaritles to *Pseudobarroisisceras* (?) *boreaui* (de Grossouvre, 1894) (p. 111, pl. 7, fig. 3); see revision in Kennedy, 1984a (p. 102, pl. 21, fig. 3; pl. 22, fig. 1-12; text-fig. 39d-e), but this lacks ventral tubercles and has broadly rounded ventrolateral shoulders, the venter flattened rather than fastigiate.

Occurrence : Middle Coniacian *tridorsatum* Zone (? and Upper Coniacian *margae* Zone) of the Corbières.

Subfamily Peroniceratinae Hyatt, 1900
(*nom. transl.* Wright 1957 (p. L428)
(*ex* Peroniceratidae Hyatt, 1900 (p. 589))
Genus and Subgenus *Peroniceras* de Grossouvre, 1894
(for synonymy see Klinger & Kennedy 1984 (p. 138))

Type species : *Peroniceras moureti* de Grossouvre, 1894 (p. 100, pl. 11, fig. 4) (= *Ammonites tridorsatus* Schlüter, 1867 (p. 26, pl. 5, fig. 1), by original designation.

Peroniceras tridorsatum (Schlüter, 1867)

1867. *Ammonites tridorsatus* Schlüter (p. 26, pl. 5, fig. 1).
1984. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schlüter, 1867): Klinger & Kennedy (p. 139, fig. 3-15, 16d-e (with full synonymy)).
1984a. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schlüter, 1867); Kennedy (p. 62, pl. 11, fig. 3-6; pl. 12, fig. 1-5; pl. 13, fig. 5-11; pl. 14, fig. 1, 4 : text-fig. 13g, 1; 18c-e; 19).
1988. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schluter); Szász & Ion (p. 119, pl. 7, fig. 4-6; pl. 8, fig. 5-7).
1989. *Peroniceras tridorsatum* (Schlüter); Küchler & Ernst (pl. 2, fig. 6).
1991a. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schlüter, 1867); Kennedy & Cobban (p. 36, pl. 6, fig. 3, 4 (with additional synonymy)).
1992. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schlüter, 1867); Vasícek (p. 171, pl. 4, fig. 1; pl. 5, fig. 1, 2; text-fig. 4-6).
1994. *Peroniceras* (*Peroniceras*) *tridorsatum* (Schluter, 1867); Kaplan & Kennedy (p. 45, pl. 14, fig. 4, 5; pl. 18, 19; pl. 20, fig. 2, 3, 6, 8; pl. 21, fig. 1-5; pl. 22, fig. 2, 3; pl. 28, fig. 1, 3, 4).

Type : The holotype (Schlüter, 1867 : p. 26, pl. 5, fig. 1), from Osterfeld, Westphalia, is lost.

Discussion : de Grossouvre (1894 : pl. 10, fig. 3) described and illustrated a superb specimen of this species from the 'Calcaires de la base de l'étage Sénonien, Chemin de Rennes-les-Bains, à Montferrand (Aude)'. 150 mm in diameter, it has the characteristic ornamentation of primary ribs only, 43 per whorl. Ill-preserved fragments (SP unregistered; M13, University of Montpellier Collection SEN-054, from 'Sous bergeries, 2 km E. of Soulatgè'), also belong here.

Peroniceras (*P.*) *subtricarinatum* (d'Orbigny, 1850) (p. 212), see below, and revision in Kennedy 1984a (p. 71, pl. 12, fig. 6-9; text-fig. 21); Klinger & Kennedy 1984 (p. 157, fig. 19a, b, d-e; 20-23); Kaplan & Kennedy, 1994 (p. 47, pl. 23-25) has coarser, branching and intercalated ribs, rather than the even primaries of the present species. *Peroniceras* (*P.*) *westphalicum* (Von Strombeck, 1859) (p. 56); see revision in Kennedy, 1984 (p. 71, pl. 14, fig. 5; pl. 15, fig. 1-3, 6-7); Klinger & Kennedy, 1984 (p. 164, fig. 24-28); Kaplan & Kennedy, 1994 (p. 48, pl. 20, fig. 1, 4, 5, 7; pl. 21, fig. 2, 3, 6; pl. 22, fig. 1; pl. 26; pl. 27, fig. 1, 3-5; pl. 43, fig. 1, 2) has frequently birfurcating and intercalated ribs on the inner whorls; on the outer whorls, ribs generally efface on the outer flank, the umbilical bullae weaken but ventral clavi persist. *Peroniceras* (*P.*) *dravidicum* (Kossmat, 1895) (p. 190, pl. 22, fig. 3); see revision in Kennedy, 1984a (p. 78, pl. 15, fig. 4-5; text-fig. 13i, j; 18f; 22); Klinger & Kennedy, 1984 (p. 170, fig. 29-42) has weak lateral keels, and ribs that branch from umbilical bullae.

Occurrence : *Peroniceras* (*P.*) *tridorsatum* is the Middle Coniacian index species, known from Münster Basin in Germany, the Boulonnais, Touraine, Aquitaine, Drôme, Var, the Corbières, Alpes-Maritimes and Alpes-de-Haute-Provence in France, northern Spain, Italy, Romania, the Czech Republic, North Africa, Zululand (South Africa), Madagascar, Texas and New Mexico in the United States.

Peroniceras (*Peroniceras*) *subtricarinatum* (d'Orbigny, 1850)
Pl. 20 fig. 3-5, 9, 11, 12; Fig. 23

1841. *Ammonites tricarinatus* d'Orbigny (p. 307, pl. 91, fig. 1, 2) (*non* Poitiez & Michaud, 1838).
1850. *Ammonites subtricarinatus* d'Orbigny (p. 212).
1984. *Peroniceras* (*Peroniceras*) *subtricarinatum* (d'Orbigny, 1850); Klinger & Kennedy (p. 157, fig. 19a, b, d-e 20-23 (with full synonymy)).
1984a. *Peroniceras* (*Peroniceras*) *subtricarinatum* (d'Orbigny, 1850); Kennedy (p. 71, pl. 12, fig. 6-9; text-fig. 21).
? 1988. *Peroniceras subtricarinatum* (d'Orbigny), 1840; Thomel (p. 51, text-fig. 26, 27).
1989. *Peroniceras subtricarinatum* (d'Orbigny); Küchler & Ernst (pl. 3, fig. 1).
1994. *Peroniceras* (*Peroniceras*) *subtricarinatum* (d'Orbigny, 1850); Kaplan & Kennedy (p. 47, pls 23, 24, 25).

Types : Lectotype, by the subsequent designation of Klinger & Kennedy, 1984 (p. 160) is the larger of the two specimens registered as no 7183 in the d'Orbigny Collection, housed in the Musèum National d'Histoire Naturelle, Paris, from the environs of Sougraigne, near Rennes-les-Bains, Aude, France (d'Orbigny, 1841 : pl. 91, fig. 1, 2 : pl. 20, fig. 3-5). A smaller specimen with the same number is a paralectotype (pl. 20, fig. 9).

Description : The types are composite internal moulds in rusty-weathering brown sandstone. The lectotype (Pl. 20, fig. 3-5) is deformed into an ellipse, major diameter 73.5 mm, minor diameter 69.0 mm. The paralectotype (Pl. 20, fig. 9) is 28.5 mm in diameter. Coiling is very evolute, serpenticone, with a broad, shallow umbilicus; the ventrolateral tubercle of the previous whorl is visible in the umbilical seam of the succeeding one. In the lectotype, the whorl section is quadrate, depressed, with greatest breadth at the umbilical bullae; whorl breadth-to-height ratio 1.20, although this has been increased by distortion. There are 24 primary ribs on the outer whorl, which arise at the umbilical seam and bear strong, prominent umbilical bullae which give rise to strong, broad, distant primary ribs. Probably originally prorsiradiate, they now vary from strongly prorsiradiate and concave to rectiradiate and straight as a result of *post-mortem* distortion. Most primary ribs arise singly from bullae, but there are occasional pairs of primaries springing from a bulla. Shorter intercalated ribs are inserted between most primaries to give a total of 38 ribs per whorl. All ribs bear a strong clavate ventrolateral tubercle. Venter poorly preserved, with three strong continuous keels, central one strongest, flanked by deep grooves; outer keels separated from ventral clavi by shallower groove. PM St II (Pl. 20, fig. 12) is somewhat larger, with an estimated maximum diameter of 85 mm. There are 20 umbilical bullae and a total of 30 ribs on the inner whorls at a diameter of 55 mm. PM ST III (Fig. 23) is 135 mm in diameter, with most or all of the last whorl body-chamber. Ornament is particularly coarse on the outer whorl, with primary and intercalated ribs, all with coarse tubercles, alternating regularly. Fragments of comparable size in the Toucas Collection (SP unregistered, labelled 'Coniacian supérieur à *Micraster brevis*, Ravin de Montferrand, Montagne des Cornes') have similar if more subdued ornamentation.

Discussion : The very evolute coiling, slowly expanding whorls, coarse ribs arising in pairs from umbilical bullae and intercalating to a large size, all characterize this species. *P.* (*P.*) *tridorsatum* (Schlüter, 1867) and *P.* (*P.*) *lepeei* (Fallot, 1885) (see discussion in Klinger & Kennedy, 1984, Kennedy, 1984a; Kaplan & Kennedy, 1994) have narrow, predominantly single, primary ribs throughout ontogeny. *P.* (*P.*) *westphalicum* (Von Strombeck, 1859) (see below) has a higher, more rapidly expanding whorl section, with consequently

FIGURE 23

Peroniceras (*Peroniceras*) *subtricarinatum* (d'ORBIGNY, 1850).
PM ST III, Middle Coniacian *tridorsatum* Zone, Soulatgé. Figure is x 1.

smaller umbilicus, the ribs effacing on the outer flank in middle and later growth. *P.* (*P.*) *dravidicum* (KOSSMAT, 1895), has delicate ornament and is flat-sided, with weak lateral keels.

Occurrence : Middle Coniacian *Peroniceras tridorsatum* Zone where well dated. In Germany the species occurs in the Münster Basin, and is also known from Switzerland, the Czech Republic, Nord, northern Aquitaine, the Beausset Basin (Var), and the Corbières (Aude) in France, where it is known from the top of the Calcaires de Montferrand; Spain, North Africa, Zululand (South Africa), Madagascar and Mexico.

Peroniceras (*Peroniceras*) *westphalicum* (VON STROMBECK, 1859)

1859. *Ammonites westphalicus* VON STROMBECK (p. 56).
1984. *Peroniceras* (*Peroniceras*) *westphalicum* (VON STROMBECK, 1859); KLINGER & KENNEDY (p. 164, fig. 24-28 (with synonymy)).
1984a. *Peroniceras* (*Peroniceras*) *westphalicum* (VON STROMBECK, 1859); KENNEDY (p. 71, pl. 14, fig. 5; pl. 15, fig. 1-3, 6-7).
1991a. *Peroniceras* (*Peroniceras*) *westphalicum* (VON STROMBECK, 1859); KENNEDY & COBBAN (p. 48, pl. 12, fig. 10, 11).
1994. *Peroniceras* (*Peroniceras*) *westphalicum* (VON STROMBECK, 1859); KAPLAN & KENNEDY (p. 48, pl. 20, fig. 1, 4, 5, 7; pl. 21, fig. 2, 3, 6; pl. 22, fig. 1; pl. 26; pl. 27, fig. 1, 3-5; pl. 43, fig. 1, 2).

Discussion : *P.* (*P.*) *westphalicum* is poorly represented in the present collections. The best-preserved specimen is PM ST-IV, a battered nucleus 100 mm in diameter with part of an outer whorl of phragmocone preserved to a maximum whorl height of 41 mm. The material resembles that from the Münster Basin described by KAPLAN & KENNEDY (1994) and from Aquitaine described by KENNEDY (1984a).

Occurrence : Where well-dated, *P.* (*P.*) *westphalicum* characterizes the Middle Coniacian *P.* (*P.*) *tridorsatum* Zone. In Germany the species occurs in the Münster Basin; in Nord, Touraine, the Corbières and Drôme in France; Italy, Zululand (South Africa), Madagascar, Texas, New Mexico and Wyoming in the U.S. Western Interior and, possibly, Japan.

Peroniceras (*Peroniceras*) *lepeei* (FALLOT, 1885)
Pl. 21, fig. 13

1885. *Ammonites* (*Schloenbachia*) *L'Epeei* FALLOT (p. 231, pl. 1, fig. 2).

1939. *Mortoniceras serrato-marginatum* Redtenbacher; Basse (p. 49).
1984a. *Peroniceras* (*Peroniceras*) *lepeei* (Fallot, 1885): Kennedy (p. 68, pl. 11, fig. 1, 2; pl. 12, fig. 10-11; pl. 14, fig. 2, 3; text-fig. 20a (with synonymy)).

Holotype : By monotypy, the original of Fallot, 1885 (p. 231, pl. 1, fig. 2, 2a) from the 'Grès vert sènonien' at Dieulefit, Drôme, France, in the Collections of the Institut Dolomieu, Grenoble.

Description : UM SEN-049 is the basis of *Mortoniceras serrato-marginatum* Redtenbacher *in* Basse (1939). The specimen is a composite mould, deformed into an ellipse 102.5 mm in diameter (Pl. 31, fig. 13). Coiling is very evolute, the umbilicus comprising 42 % of the diameter. Ornament is of narrow crowded prorsiradiate primary nbs, an estimated 46 on the outer whorl, with no, or only incipient umbilical bullae, and small but well-differentiated ventrolateral clavi. The venter is markedly tricarinate-bisulcate.

Discussion : See Kenneoy (1984a : p. 70) for a discussion of differences from other species. The *P.* (*P.*) aff. *lepeei* of Kennedy (1984a : p. 19, fig. 8) from Dieulefit is near-identical in proportions and ribbing, but has well-marked spiral ridges and grooves.

Occurrence : Middle Coniacian *tridorsatum* Zone in the Corbières, Dieulefit, Sarthe or Touraine in France, Italy and Zululand, South Africa.

Subgenus *Zuluiceras* Van Hoepen, 1965
(for synonymy see Klinger & Kenneoy, 1984 (p. 180))

Type species : *Zuluiceras zulu* Van Hoepen, 1965 (p. 9, pl. 5, text-fig. 1g-i, 2b).

Peroniceras (*Zuluiceras*) cf. *bajuvaricum* (Redtenbacher, 1873)
Pl. 20, fig. 7, 8

Discussion : Material from the Corbières consists of fragments only, with maximum preserved whorl heights of up to 27 mm. See Kennedy (1984a : p. 80, pl. 16, fig. 1-3, 6-11, pl. 17, fig. 1-3; text-fig. 13k, 20b, c, e; 23, 24, 25) for a full account of the species.

Occurrence : Middle Coniacian *tridorsatum* Zone in the Corbières. Elsewhere the species has been regarded as both Middle and Upper Coniacian. There are records from the Calcaires Durs de La Ribochère of Villedieu-le-Château in Touraine, the Calcaire de Cangey of Cangey, Indre-et-Loire, Assize L[1] of Arnaud near Cognac (Charente-Maritime) (de Grossouvre, 1984), and Var, all in France; Austria, Italy, the Czech Republic, South Africa and Japan.

Peroniceras (*Zuluiceras*) *isamberti* (Fallot, 1885)
Pl. 20, fig. 1, 2

1885. *Ammonites* (*Schloenbachia*) *isamberti* Fallot (p. 232, pl. 1, fig. 1).
1894. *Gauthieras bajuvaricum* Redtenbacher sp.; de Grossouvre (p. 88 (*pars*)).
1965. *Sornayceras isamberti* (Fallot); Matsumoto (p. 232).
1984a. *Peroniceras* (*Zuluiceras*) *isamberti* (Fallot, 1885); Kennedy (p. 86, pl. 16, fig. 12-14).

Lectotype : Designated by Kennedy, 1984a (p. 86) is a specimen in the collections of Laboratoire de Gèologie, Institut Dolomieu, Grenoble, the original of Fallot, 1885 (pl. 2, fig. 1) from the Middle Coniacian of Dieulefit, Drôme, France.

Discussion : Material from the Corbières (PMRO11) (Pl. 20, fig. 1, 2) consists of crushed fragments only, with whorl heights of up to 25 mm, but showing the rather coarse ribbing and markedly clavate ventrolateral tubercles characteristic of the species. See Kennedy (1984) for a full account of *P.* (*Z.*) *isamberti*.

Occurrence : Middle Coniacian *tridorsatum* Zone of Dieulefit, Drôme, France; *tridorsatum* Zone and Upper Coniacian *margae* Zone in the Corbières.

Peroniceras (*Zuluiceras*) sp. nov.
Pl. 20, fig. 10

1984a. *Zuluiceras* sp. nov. Kennedy (p. 86, pl. 17, fig. 4, 5).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP unregistered	93.5 (100)	16.9 (18.1)	38.5 (41.2)	0.44	26.5 (28.3)

Description : An unregistered specimen in the Sorbonne Collections is badly crushed and 93.5 mm in diameter. Coiling is moderately involute, comprising 28.3 % of the diameter, shallow, with a low, rounded wall and narrowly rounded umbilical shoulder. The whorls are high and compressed, with a sharp median keel flanked by shallow grooves, the edges of which are strengthened into feeble incipient lateral keels. Ornament is of crowded low ribs that arise singly, rarely in pairs, from feebly concave umbilical bullae, are straight and prorsiradiate across the flanks and terminate in feebly clavate ventral tubercles that total an estimated 16-18 on the last half whorl.

Discussion : Although crushed, this specimen appears conspecific with the better-preserved *P.* (*Z.*) sp. nov. of Kennedy (1984a : p. 86, pl. 17, fig. 4, 5).

Occurrence : The present specimen is labelled 'Coniacien supèrieur à *Micraster brevis*, chemin de Bugarach à Linas'; the species also occurs in the Middle Coniacian *P. tridorsatum* Zone Grès Verts de Dieulefit of Dieufefit (Drôme).

Subfamily Texanitinae Collignon, 1948
(*nom. transl.* Wright 1957 (p. 429)
ex Texanitidae Collignon, 1948 (p. 54(9))
Genus and subgenus *Protexanites* Matsumoto, 1955

Type species : *Ammonites bourgeoisianus* d'Orbigny, 1850 (p. 212) by original designation by Matsumoto, 1955 (p. 38).

Protexanites (*Protexanites*) *bourgeoisianus* (d'Orbigny, 1850)
Pl. 19, fig. 5; Pl. 21, fig. 12, 15

1850. *Ammonites bourgeoisianus* d'Orbigny (p. 212).
1984a. *Protexanites bourgeoisi* (d'Orbigny, 1850); Kennedy (p. 105, pl. 23, fig. 1-4, 7-9; pl. 24, fig. 1-8; pl. 26, fig. 4, 5; text-fig. 32-34; 35a-e; 36b, c, e, f (with full synonymy)).
1991a. *Protexanites* (*Protexanites*) *bourgeoisianus* (d'Orbigny, 1850); Kennedy & Cobban (p. 44, pl. 7, fig. 18, 19, 22-27; pl. 8, fig. 1-4, 6-9, 11-13; pl. 12, fig. 12; text-fig. 17-21, 22b (with additional synonymy)).
1994. *Protexanites* (*Protexanites*) *bourgeoisianus* (d'Orbigny, 1850); Kaplan & Kennedy (p. 49, pl. 27, fig. 2; pl. 28, fig. 6, 7).

Types : The lectotype, designated by Matsumoto (1966 : p. 202), is MNHP 7181a1; paralectotypes MNHP 7181a2-5, all from the Upper Coniacian *Paratexanites serratomarginatus* Zone, Couche à *Ostrea auricularis* of the Craie de Villedieu of St. Fraimbault, Sarthe, France. Paralectotype MNHP 7181 is from the same horizon at Villedieu, Loir-et-Cher, France, and is a *Paratexanites serratomarginatus*.

Discussion : *P.* (*P.*) *bourgeoisianus* is not uncommon in the Corbières; we have twenty specimens, most from the Chemin de La Jouane section. The material ranges from juveniles as little as 17 mm in diameter to adults, the largest of which is an estimated 200 mm in diameter. Although crushed, the present material differs

in no significant respects from the type and other specimens from Touraine revised by KENNEDY (1984a) and the better-preserved material from the U.S. Western Interior described by KENNEDY & COBBAN (1991a).

Occurrence : This species first appears as a great rarity at the top of the lower Upper Coniacian *Gauthiericeras margae* Zone in Touraine (KENNEDY 1984a : text-fig. 34) and the Corbières, and is common in the succeeding *Paratexanites serratomarginatus* Zone in Sarthe, Touraine, northern Aquitaine in France, and correlatives in Germany, Austria, northern Spain, Algeria, Tunisia, Wyoming, Montana and Colorado in the U.S. Western Interior.

Protexanites (*Protexanites*) *bontanti* (de GROSSOUVRE, 1894)
Pl. 21, fig. 1, 4, 5, 10, 11, 16

1894. *Protexanites bontanli* de GROSSOUVRE (p. 77, pi. 17, fig. 2; text-fig. 23).
1984a. *Protexanites bontanti* (de GROSSOUVRE, 1894); KENNEDY (p. 112, pi. 25, fig. 1-4; text-fig. 36a (with full synonymy)).
1991a. *Protexanites* (*Protexanites*) *bontanti* (de GROSSOUVRE, 1894); KENNEDY & COBBAN (p. 50, pi. 7, fig. 38-41; pi. 8, fig. 5, 10; text-fig. 4d).

Types : The holotype by original designation is the original of de GROSSOUVRE, 1894 (p. 77, pl. 17, fig. 2) an unregistered specimen in the collection of the Musèum National d'Histoire Naturelle, Paris; the figured paratype (de GROSSOUVRE, 1894 (pl. 17, fig. 3) has not been traced. Both were from the Upper Coniacian *Paratexanites serratomarginatus* Zone fauna of the Couche à *Ostrea auricularis* in the Craie de Villedieu at Villedieu, Loir-et-Cher, France.

Discussion : The Corbières specimens are all small, none exceeding 45 mm in diameter. They are crushed, but closely resemble well-preserved juveniles from the U.S. Western Interior described by KENNEDY & COBBAN (1991a). Small umbilicus, compressed whorls and crowded flexuous ribs easily distinguish *P.* (*P.*) *bontanti* from *P.* (*P.*) *bourgeoisianus* and other species at the genus.

Occurrence : Upper Coniacian *P. serratomarginatus* Zone in the Corbières, Touraine and northern Aquitaine in France, and Wyoming in the U.S. Western Interior. Subspecies *shimizui* is from the Santonian of Hokkaido, Japan, and Saghalien (MATSUMOTO, 1970b : p. 237, pl. 31, fig. 1, 2; text-fig. 6); MATSUMOTO, 1971 (p. 146, pf. 23, fig. 4; text-fig. 10) and has also been recorded from the Coniacian of Provence by THOMEL (1988).

Protexanites (*Protexanites*) sp.
Pl. 19, fig. 2

Discussion : PM SO2 is part of the body-chamber and penultimate whorl of a *Protexanites*. The penultimate whorl fragment shows parts of five very distant, narrow ribs with strong conical submarginal, and weaker, very elongate external clavi on either side of a sharp, undulose siphonal keel. The body-chamber fragment has a maximum preserved whorl height of 39 mm. Parts of eight ribs are preserved. They arise at feeble umbilical bullae, are straight and recti- to feebly rursiradiate on the flank, with submarginal tubercles of moderate strength, connected by a broad, blunt, prorsiradiate rib to a weak external clavus.

The style and direction of ribbing on this fragment (the latter, perhaps modified by compaction) is quite unlike that of other *Protexanites* (*Protexanites*) from the Corbières. The closest comparison is with *P.* (*P.*) *peroni* MATSUMOTO, 1970b (= *Peroniceras czörnigi* PERON (*non* REDTENBACHER), 1896 : p. 53, pi. 5(11), fig. 7), from the base of the 'Sénonien' of Djebel Aures, Algeria.

Occurrence : Middle Coniacian *tridorsatum* Zone in the Corbières.

Genus *Aneuretoceras* KENNEDY & COBBAN, 1991a

Type species : *Aneuretoceras variabile* KENNEDY & COBBAN, 1991a (p. 53 pl. 7, fig. 1-17, 20, 21; text-fig. 24).

Aneuretoceras variabile KENNEDY & COBBAN, 1991a
Pl. 21, fig. 6, 7

1991a. *Aneuretoceras variabile* KENNEDY & COBBAN (p. 53, pi. 7, fig. 1-17, 20, 21; text-fig. 24).

Type : Holotype is US National Museum of Natural History Collection no. 433 808, from the Upper Coniacian Cody Shale in the Oregon Basin, Park County, Wyoming (KENNEDY & COBBAN, 1991a : pl. 7, fig. 16, 17). There are numerous paratypes.

Description : PM K1-19 is a body-chamber fragment with a maximum preserved whorl height of 4.7 mm. Coiling appears to have been evolute, the whorls slowly expanding, compressed, with feebly convex inner flanks, convergent outer flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. Eight ribs are preserved on the fragment. They are narrow, straight and feebly prorsiradiate on the inner and middle flank, and flex forward, broaden and are concave on the ventrolateral shoulder, crossing the venter in an obtuse, rounded chevron.

Discussion : The present specimen is significantly larger than the North American type material, but differs in no significant respects from the body-chamber ornament of the holotype and paratype figured by KENNEDY & COBBAN, 1991a (pi. 7, fig. 14-17).

Occurrence : Upper Coniacian *serratomarginatus* Zone in the Corbières; otherwise as for types.

Genus *Paratexanites* COLLIGNON, 1948
(= *Parabevahites* COLLIGNON, 1948 : p. 63(18)).

Type species : *Mortoniceras zeilleri* de GROSSOUVRE, 1894 (p. 67, pl. 14, fig. 1) by original designation by COLLIGNON, 1948 (p. 45 (102)).

Paratexanites zeilleri (de GROSSOUVRE, 1894)
Pl. 22, fig. 12; pl. 23, fig. 1, 2; Fig. 20E, 24

1894. *Mortoniceras zeilleri* de GROSSOUVRE sp. (p. 67 (*pars*), pl. 14, fig. 1).
1984a. *Paratexanites zeilleri* (de GROSSOUVRE, 1894); KENNEDY (p. 115, text-fig. 37 (with synonymy)).

Lectotype : By the subsequent designation of MATSUMOTO, 1970b (p. 249) is the original of de GROSSOUVRE, 1894 (pl. 67 (*pars*), pl. 14, fig. 1) (cast refigured by KENNEDY, 1984a : text-fig. 37), from the Calcaires durs de la Ribochère of the Carrière de la Ribochère, Couture, Loir-et-Cher, France.

Description : The smallest well-preserved specimen is PM RO-19, with an original estimated diameter of 53.5 mm. 12 primary ribs are preserved on the fragment. They arise at the umbilical seam, and strengthen into small bullae on the umbilical shoulder. These give rise to broad, straight, prorsiradiate ribs that bear a conical submarginal tubercle linked by a broad, prorsiradiate rib to a subequal clavate marginal tubercle. A much-effaced prorsiradiate rib connects to a strong external clavus, separated by a groove from a coarse undulose siphonal keel (Pl. 23, fig. 1, 2) PM RO10 and PM RO23 are similar individuals. Large individuals such as PM SO1 have 24-25 ribs at 110 mm diameter, and 125 mm diameter in PM RO6, where inner-flank ribbing is coarse, the umbilical tubercle having migrated out to an inner lateral position, as in the largest specimen, PM JO-5 (Fig. 24) with 28 ribs on the outer whorl at 215 mm diameter.

Discussion : Coarse ribbing, with widely separated submarginal and marginal tubercles readily separate *P. zeilleri* from *P. serratomarginatus* (REDTENBACHER, 1873) from the Corbières (compare Pl. 21, fig. 14 and Fig. 24).

Occurrence : Middle Coniacian *tridorsatum* Zone and Upper Coniacian *margae* Zone in the Corbières. The species also occurs in the Middle Coniacian or lower Upper Coniacian of Touraine.

FIGURE 24

Paratexanites zeilleri (de GROSSOUVRE, 1849).
PM JO-5, Middle Coniacian *tridorsatum* Zone, Les François. Figure is reduced x 0.75.

Paratexanites serratomarginatus (REDTENBACHER, 1873)
Pl. 21, fig. 14

1873. *Ammonites serrato-marginatus* REDTENBACHER (p. 110, pl. 25, fig. 2).
1984a. *Paratexanites serratomarginatus* (REDTENBACHER, 1873); KENNEDY (p. 117, pl. 23, fig. 5, 6; pl. 26, fig. 1-3; pl. 27, fig. 1-7; text-fig. 35f, g).

Types : REDTENBACHER based this species on seven syntypes from the Coniacian Gosau Beds of Glanegg, Austria. No. 6381, the original of REDTENBACHER, 1873 (pl. 25, fig. 2a-b), preserved in the collections of the Haus der Natur, Salzburg, Austria, has been designated lectotype by KENNEDY *et al.* (1981b : p. 117). The other paralectotypes are either in this collection or the collections of the Oberosterreichisches Landesmuseum, Linz, Austria (see KENNEDY *et al.*, 1981 for details).

Description : UPST G01 is a composite internal mould, the original diameter of which was at least 140 mm. Coiling is very evolute, the umbilicus broad and shallow, comprising 41 % approximately of the diameter, the umbilical wall low, flattened, undercut, with a narrowly rounded shoulder. The whorl section is compressed, with an intercostal whorl breadth-to-height ratio of 0.74, the whorl section compressed oval-trapezoidal. The costal whorl section is trapezoidal-polygonal with the greatest breadth below mid-flank.

Ornament is of numerous primary ribs. All arise at feeble umbilical bullae and are single, save at the smallest diameters visible, where occasional pairs of ribs arise from a single bulla. There are 35-36 ribs on the penultimate whorl, and 34-35 on the outer. The ribs are narrow, straight and prorsiradiate, narrower than the interspaces and at maximum strength across the middle of the flanks. All terminate in a small, clavate submarginal tubercle, linked by a broad rib to a somewhat larger, clavate marginal tubercle. The venter is damaged, but there appears to have been a siphonal keel flanked by grooves, the outer edges of which are strengthened into feeble lateral keels, with traces of external tubercles.

Discussion : *P. serratomarginatus* are generally more finely and densely ribbed than *P. zeilleri* (de Grossouvre, 1894) (see above), with submarginal and marginal tubercles closely approximated.

Occurrence : Upper Coniacian *P. serratomarginatus* Zone, Touraine, Aquitaine, the Corbières, Castellane (Alpes-de-Haute-Provence), and Beausset Basin (Var) in France, Austria and Japan.

Genus and subgenus *Texanites* Spath, 1932

Type species : *Ammonites texanus* Roemer, 1852 (p. 31, pl. 3, fig. 1) by original designation by Spath, 1932 (p. 379).

Texanites (*Texanites*) *gallicus* Collignon, 1948
Pl. 22, fig. 11; Fig. 25

1894. *Mortoniceras texanum* F. Römer sp.; de Grossouvre (p. 80, pl. 16, fig. 2, 4; pl. 17, fig. 1).
1987. *Texanites* (*Texanites*) *gallicus* Collignon, 1948; Kennedy (p. 770, pl. 80, fig. 4-7; pl. 81, fig. 1-6 (with synonymy)).
1994. *Texanites* (*Texanites*) *gallicus* Collignon; Wiedmann (p. 238, pl. 44, fig. 1, 3, 4; pl. 35, fig. 3-6; text-fig. 16c).

Type : Lectotype, by the subsequent designation of Collignon, 1948 (p. 42(99)) is the original of de Grossouvre, 1894 (pl. 17, fig. 1). This specimen has not been traced, but plaster casts survive in a number of collections (MNHP, FSL); the original (Fig. 25) was from the 'Marnes bleues à petits fossiles situées au bas du chemin de Sougraigne aux Croutets (Aude), sous la couche à *Lima marticensis*'.

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
Lectotype (cast)	118.0 (100)	- (-)	42.5 (36.1)	-	47.7 (40.4)

Description : The lectotype is the best-preserved specimen from the Corbières. A cast is 118 mm in diameter. Coiling is very evolute, the marginal tubercle visible within the umbilical wall of the succeeding whorl. The umbilicus comprises 40.4 % of the diameter, is shallow, with a low, outward-inclined wall and more narrowly rounded umbilical shoulder. The whorl section appears to have been slightly compressed, and polygonal in costal section. There are 28 ribs on the outer whorl : all are primaries, and arise on the umbilical wall. They strengthen into a well-marked, sharp, feebly bullate umbilical tubercle, which gives rise to a strong, straight, distant, prorsiradiate rib with a stronger conical lateral tubercle and even stronger marginal tubercle. The external tubercle is weaker and clavate. It is separated from the marked siphonal keel by a narrow ventral groove. The inner whorls, so far as visible, bear exclusively primary ribs.

Discussion : Collignon (1948), Kennedy (1987) and Wiedmann (1994) have reviewed this species. It is closely allied to *T. quinquenodosus* (Redtenbacher, 1873), as revised by Kennedy, Summesberger & Klinger (1981b), and discussed further below. They differ in the markedly clavate tubercles of *quinquenodosus* compared to the rounded tubercles of *gallicus*. These are slight differences, but available material does not provide enough variation data to show them to be intraspecific vanants and they are kept separate at this time.

Occurrence : Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones in the Corbières. Lower (and Middle?) Santonian, Assize M^1 and M^2 in Aquitaine; northern Spain, Bulgaria, ? Italy, Venezuela, Zululand (South Africa) and Madagascar.

Texanites (*Texanites*) *quinquenodosus* (Redtenbacher, 1873)
Pl. 22, fig. 8, 10; Pl. 23, fig. 3-5; Fig. 26.

1873. *Ammonites quinquenodosus* Redtenbacher, (p. 108, pl. 24, fig. 3).
1981a. *Texanites quinquenodosus* (Redtenbacher, 1873); Kennedy, Klinger & Summesberger (p. 26, fig. 8-16 (with full synonymy)).

Type : Lectotype, designated by Matsumoto, 1970b (p. 273) is no. 1873/01/13 in the collections of the Geologische Bundesanstalt, Vienna, from the Santonian Gosau Beds of St Wolfgang, Ischl, Austria, the original of Redtenbacher, 1873 (pl. 24, fig. 3) refigured here as Figure 26.

Description : The early growth stages of specimens from the Corbières tend to be crushed; the best of these is shown as Plate 23, figure 3. Coiling is very evolute, the umbilicus comprising around 46 % of the diameter; the whorls expand very slowly. 28 bullae perch on the umbilical shoulder and give rise to one, rarely two, primary ribs to give a total of 32 to 34 ribs at the ventrolateral shoulder.

Ribs are straight, close-spaced, prorsiradiate, and strengthen and broaden across the flanks. They bear small clavate lateral, stronger clavate submarginal, even stronger, clavate marginal, and slightly weaker, very elongate external clavi, separated by a pronounced groove from the strong siphonal keel. A much less deformed fragment with a whorl height of 30 mm is shown as Plate 23, figures 4, 5; it suggests that the original whorl section was compressed. Larger still is MNHP R 52580 (Pl. 22, fig. 10) 115 mm in diameter, with 16 primary ribs per whorl. At this growth stage the lateral tubercles are only feebly clavate, the submarginal, marginal and external markedly so, a condition matched in the lectotype (Fig. 26).

Discussion : *Texanites quinquenodosus* and *T. gallicus* are closely allied, as noted above. They differ in the markedly clavate tubercles of the present species as opposed to rounded in *gallicus*, a feature well-displayed by specimens from the Corbières, which also tend to be more densicostate.

Occurrence : Middle Santonian *gallicus* Subzone in the Corbières. 'Lower' Santonian of southeastern France and Hokkaido, Japan, Santonian of Austria, and, doubtfully, Angola; Upper Santonian of Madagascar.

Texanites (*Texanites*) *americanus* (Lasswitz, 1904)
Pl. 23, fig. 6

1904. *Schloenbachia bourgeoisi* d'Orbigny var. *americana* Lasswitz (p. 252(32) pl. 20(8), fig. 1).
1928. *Mortoniceras americanum* (Lasswitz); Adkins (p. 252).
1948. *Texanites bourgeoisi* (d'Orbigny) var. *americanum* (Lasswitz); Collignon (p. 41).
1963. *Texanites americanus* (Lasswitz, 1904); Young (p. 83, pl. 41, fig. 1, 3; pl. 44, fig. 2, 3; pl. 48, fig. 1, 3; pl. 57, fig. 5; text-fig. 24c).

Type : Young (1963 : p. 83, pl. 44, fig. 2, 3) illustrated and designated University of Texas Memorial Museum Collections no UT-563 neotype of *Texanites* (*Texanites*) *americanus*; it is from the Lower Santonian Austin Chalk of Texas. The figured syntype of Lasswitz (1904 : pl. 20(8), fig. 1) is not in fact lost, as Young presumed, but survives in the collections of Wroclaw University, Poland.

Description : PM G6-6 (Pl. 23, fig. 6) is part of two crushed whorls, deformed into an ellipse with a maximum diameter of 240 mm. Coiling is very evolute, the submarginal tubercle exposed in the

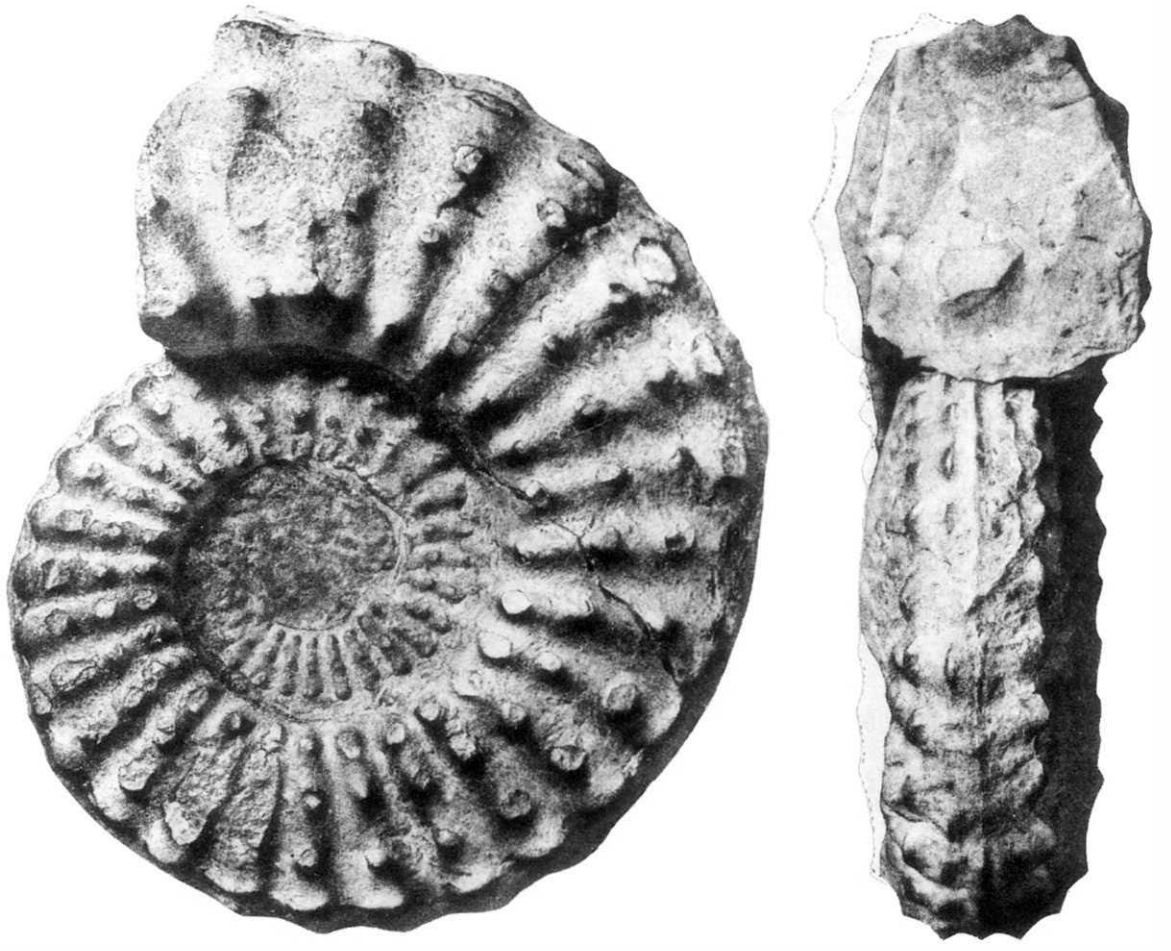

FIGURE 25

Texanites (*Texanites*) *gallicus* COLLIGNON, 1948.
The holotype, the original of de GROSSOUVRE, 1894 (pl. 27, fig. 1, 2) from the 'Marnes bleues à petites fossiles situées au bas du chemin de Sougraigne aux Croutets (Aude), sous la couche à *Lima marticensis*' (copy of de GROSSOUVRE). Figure is x 1.

umbilical seam of the succeeding whorl. The whorls expand very slowly; the whorl section cannot be established due to *post-mortem* deformation. The penultimate whorl fragment bears parts of eight coarse umbilical bullae. These give rise to coarse, straight, prorsiradiate ribs with coarse conical lateral tubercles equidistant between umbilical bullae and somewhat weaker but still coarse, submarginal clavi. The strong marginal clavi are closer to the submarginal than the latter are to the lateral, and close to very elongate external clavi that tend to be linked by a spiral ridge. A coarse groove separates these ridges from a strong siphonal keel. There are three intercalated ribs on the inner whorl, with submarginal, marginal and external tubercles only. The outer whorl bears 16 ribs, all but one coarse primaries, with tubercles as on the inner whorl. The single secondary rib has submarginal, marginal and external tubercles only.

Discussion : The present fragment differs in no significant respects from the figure of LASSWITZ; very evolute coiling, coarse ribs with occasional secondaries, tubercle shape and spacing all correspond. Specimens figured by YOUNG (1963) lack intercalated ribs. See KLINGER & KENNEDY (1980 : p. 158) for a discussion of the relationship between *T. americanus* and *T. rarecostatus* COLLIGNON, 1966.

Occurrence : Santonian of Texas. Upper Santonian lower part of *paraplanum* Subzone in the Corbières.

Texanites (*Texanites*) *soutoni* (BAILY, 1855)
Pl. 23, fig. 7

1855. *Ammonites soutoni* BAILY (p. 455, pl. 11, fig. 1).
1980. *Texanites soutoni* (BAILY, 1855); KLINGER & KENNEDY (p. 189, fig. 143-151b, 152b, 153-163).
1980. *Texanites soutoni natalense* KLINGER & KENNEDY (p. 214, fig. 164-185).

Type : Holotype by monotypy in BMNH C47261, the original of BAILY, 1855 (pl. 11, fig. 1) refigured by KLINGER & KENNEDY, 1980 (text-fig. 143) and from the Upper Santonian to Lower Campanian Umzamba Formation of Umzamba Cliff, Zululand, South Africa.

Description : UPST 54 (Pl. 23, fig. 7) is part of a nucleus 85 mm in diameter, and part of an outer whorl, part body-chamber, with a maximum preserved whorl height of 65 mm, and whorl breadth-to-height ratio of 0.56 (accentuated by crushing).

Coiling appears to have been fairly evolute, the umbilicus shallow, with a flattened wall and narrowly rounded umbilical shoulder. There are ten small, sharp bullae perched on the umbilical shoulder. These correspond to 13 ribs. Long secondaries arise low on the flank and link tenuously to the bullae. Ribs are low, blunt, straight, prorsiradiate and crowded, with weak lateral bullae and weak submarginal clavi visible. The outer whorl bears 14 ribs, all primary, strong, narrow, straight and prorsiradiate on the inner to middle flank, but flexed forwards and feebly concave on outermost flank

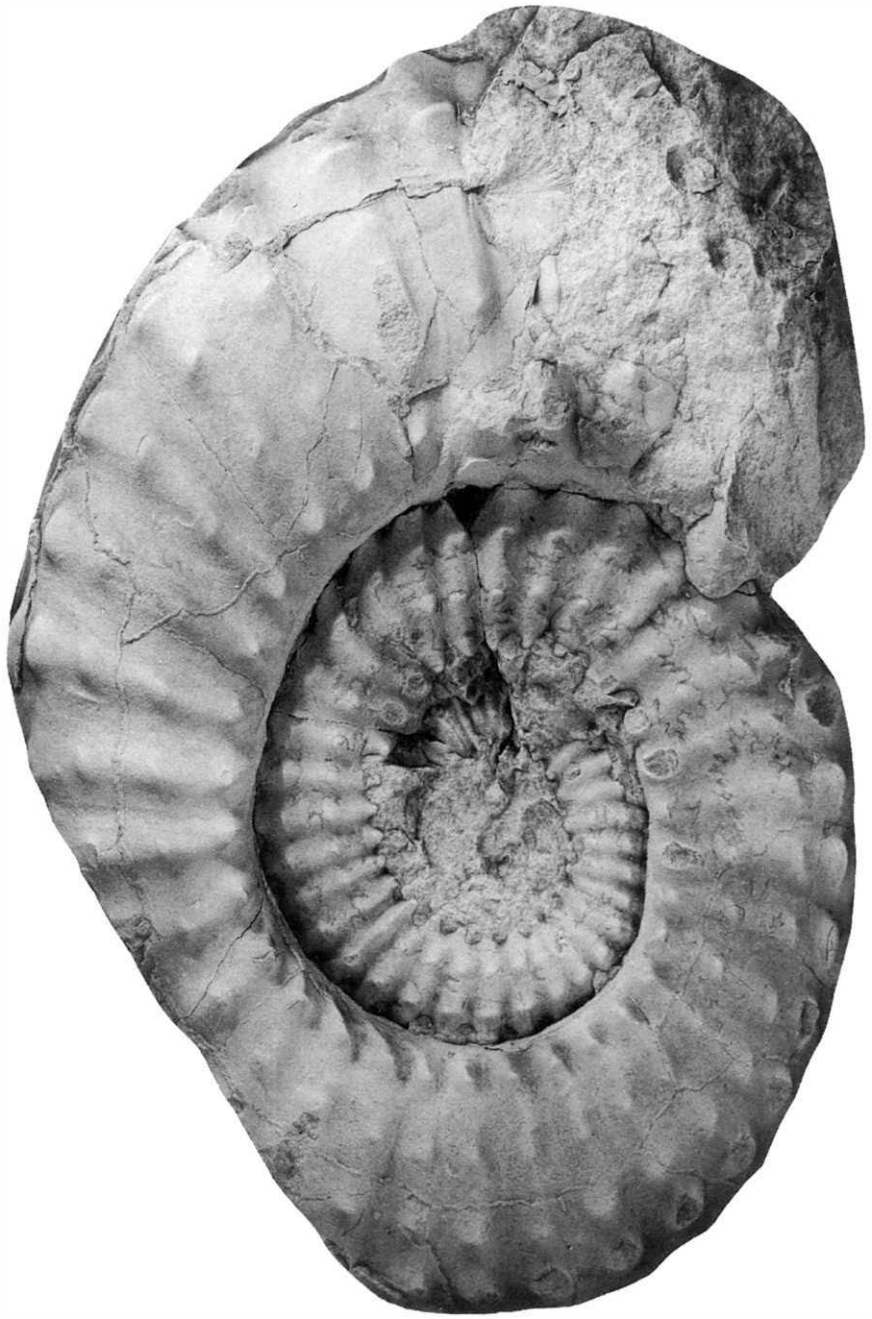

FIGURE 26

Texanites (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873).
Lectotype, no. 1873/01/13 in the collections of the Geologische Bundesanstalt Vienna, from the Santonian Gosau Beds of St Wolfgang, Ischl, Austria. Figure is × 1.

and ventrolateral shoulder. Tubercles are subordinate to ribs, with umbilical bullae, weak bullate lateral, near-effaced submarginal, strong, feebly clavate, marginal and weak external clavi.

Discussion : Whorl section, coiling, rib and tubercle pattern match those of the much larger holotype of *Texanites soutoni*. KLINGER & KENNEDY (1980) discuss this species at length, and recognized two subspecies; the present fragment probably belongs to the nominate subspecies, but is too incomplete to be certain. A few small specimens with crowded ribs and feeble tubercles may be juveniles of this species (PM K3S12) (Pl. 21, fig. 9).

Occurrence : Upper Santonian to Lower Campanian of Zululand and Pondoland (South Africa). Middle or Upper Santonian in the Corbières.

Family Tissotiidae Hyatt, 1900
Genus and subgenus *Tissotioides* Reyment, 1958a

Type species : *Ammonites haplophyllus* Redtenbacher, 1873 (p. 100, pl. 23, fig. 1) by original designation by Reyment, 1958a (p. 48).

Tissotioides (*Tissotioides*) *haplophyllus* (Redtenbacher, 1873)
Pl. 24, fig. 3, 4; Fig. 27

1873. *Ammonites haplophyllus* Redtenbacher (p. 100, pl. 23, fig. 1).
1984a. *Tissotioides* (*Tissotioides*) *haplophyllus* (Redtenbacher, 1873); Kennedy (p. 123, pl. 28 fig. 2, 3; pl. 29, fig. 3, 4; text-fig. 38a-c (with full synonymy)).

Type : The holotype by monotypy is the original of Redtenbacher, 1873 (p. 100, pl. 23, fig. 1) from the Coniacian Gosau Group of Schmölnauer Alpe, near Ströbl, Austria, in the collections of the Geologische Bundesanstalt Vienna, no. 1873/01/7, 3442, refigured by Kennedy, 1984a (text-fig. 38).

Discussion : An extensive revision of this species was given by Kennedy (1984a). The material from the Corbières is either crushed (pl. 24, fig. 3, 4) or worn, but includes the complete adult in the Sénesse Collection (Fig. 27), UM SEN022, from the 'deuxième coume à l'est de Soulatgé, région de Bugarach'. 150 mm in diameter, it has 240° of body-chamber preserved.

Occurrence : Middle Coniacian *tridorsatum* Zone in the Corbières. The type material is from the Middle Coniacian of Austria, and the species is also known from northern Aquitaine and Dieulefit (Drôme) in France, and northern Spain.

Genus *Metatissotia* Hyatt, 1903
(= *Dordiella* Reyment, 1958b (p. 59))

Type species : *Ammonites fourneli* Bayle, 1849 (p. 360, pl. 17, fig. 1-5) by the subsequent designation of Roman, 1938 (p. 479).

Metatissotia ewaldi (Von Buch, 1848)
Pl. 18, fig. 5; Pl. 24, fig. 5; Pl. 25, fig. 12-16; Pl. 26, fig. 5, 6; Fig. 28

1848a. *Ammonites ewaldi* Von Buch (p. 221, pl. 1, fig. 4).
1848b/1850. *Ammonites ewaldi* Von Buch; Von Buch (p. 26, pl. 6, fig. 6, 7; pl. 7, fig. 4).
1848b/1850. *Ammonites robini* Thiollière; Von Buch (p. 28, pl. 6, fig. 5).
1849. *Ammonites Robini* Thiollière (p. 744, pl. 1).
1984a. *Metatissotia ewaldi* (Von Buch, 1848); Kennedy (p. 127 pl. 28, fig. 4, 5; pl. 29, fig. 9-11; pl. 30, fig. 1, 2, 5, 6, 8, 9, 12; pl. 32, fig. 1-3; text-fig. 40b, e (with full synonymy)).

Types : These have not been traced, but were from Dieulefit (Drôme), France.

Description : The best-preserved juvenile is that figured by de Grossouvre (1894 : pl. 9, fig. 5) (Pl. 25, fig. 11, 12). Coiling is very involute, with a tiny, deep umbilicus comprising 9.5 % of the diameter, the umbilical wall flat and subvertical, with a sharp, narrowly rounded umbilical shoulder. The whorl section is compressed (whorl breadth-to-height ratio 0.64), with the greatest breadth at the umbilical shoulder, the inner flanks broadly rounded, the outer flanks flattened and convergent with acutely fastigiate venter. There are four blunt umbilical bullae on the last half whorl that give rise to pairs of broad, low, flat, obscure ribs that are feebly concave and connect (together with short intercalated ribs) to blunt ventral clavi, of which there are 11 on the last half whorl. The line of the ventral clavi is marked by a facet, forming a spiral ridge on the shell. Ornament declines as size increases, leaving traces of ribs on the outer flank plus clavi (Pl. 25, fig. 14) beyond which the facet may remain (Pl. 24, fig. 5) or be lost, to give an unornamented oxycone in later growth (Pl. 25, fig. 15). Our largest specimens include an individual septate to 110 mm diameter (Pl. 25, fig. 16) and one 130 mm in diameter that is part body-chamber (Pl. 24, fig. 5).

Discussion : See Kennedy (1984a : p. 128) for a discussion of differences from allied species.

Occurrence : Middle Coniacian *P. tridorsatum* Zone in the Corbières, northern Aquitaine, Dieulefit (Drôme), France; northern Spain and Austria.

Metatissotia nodosa Hyatt, 1903
Pl. 25, fig. 11

1894. *Tissotia haplophylla* Redtenbacher sp.; de Grossouvre (p. 42, (*pars*), pl. 4, fig. 3, 4, *non* 5).
1903. *Metatissotia nodosa* Hyatt (p. 47).

1984a. *Metatissotia nodosa* Hyatt, 1903; Kennedy (p. 131, pl. 29, fig. 7, 8).

Type : Lectotype by the subsequent designation of Kennedy, 1984a (p. 131) is the original of de Grossouvre, 1894 (pl. 4, fig. 3, 4) (Kennedy, 1984a : pl. 29, fig. 7, 8), an unregistered specimen in the Sorbonne collections from the Middle Coniacian of Saint-Hilaire-de-Jonzac, Charente-Maritime, France. The paralectotype has not been traced.

Discussion : PM BOa3 is the same diameter as the lectotype, from which it differs in no significant respects. See Kennedy (1984a) for a full description of the species.

Occurrence : Lower and Middle Coniacian of northern Aquitaine. Middle Coniacian *tridorsatum* Zone in the Corbières.

Metatissotia sp. 1
Pl. 24, fig. 1; Fig. 29

1937. *Tissotia redtenbacheri* de Grossouvre; Sénesse (p. 35, pl. 11, fig. 4).

Discussion : The specimen referred to *Tissotia redtenbacheri* by Sénesse (1937) is shown as Plate 24, figure 1, and Figure 29. It is wholly septate, and 110 mm in diameter, a stout oxycone, ornamented by low, broad outer flank ribs that terminate in blunt ventral clavi borne on a faceted ridge. The suture is not that of *M. redtenbacheri* (see revision in Kennedy, 1984a : p. 132, pl. 28, fig. 1; text-fig. 40a), and the specimen appears to be a member of the *M. ewaldi* group.

Occurrence : Middle Coniacian *tridorsatum* Zone of the Corbières.

Metatissotia sp. 2
Pl. 24, fig. 2; Fig. 30

1937. *Tissotia robini* Thiollière; Sénesse (p. 35, pl. 11, fig. 3).

Discussion : The original of Sénesse 1937 (p. 35, pl. 11, fig. 3) is no SEN 029 in the Collections of Montpellier University, shown as Plate 24, figure 2 and Figure 30. Wholly septate and 92 mm in diameter, the coiling is more evolute than in typical *M. ewaldi*, with much coarser umbilical bullae that persist to a much larger diameter.

Occurrence : Middle Coniacian *tridorsatum* Zone of the Corbières.

Metatissotia cf. *redtenbacheri* (de Grossouvre, 1894)
Pl. 26, fig. 1, 2

compare :
1894. *Tissotia redtenbacheri* de Grossouvre (p. 42, text-fig. 23).
1984a. *Metatissotia redtenbacheri* (de Grossouvre, 1894); Kennedy (p. 132, pl. 28, fig. 1; text-fig. 40a (with additional synonymy)).

FIGURE 27

Tissotioides haplophyllus (REDTENBACHER, 1873).
UM SEN-022, the original of SÉNESSE, 1937 (pl. 10, fig. 1) from the Middle Coniacian *tridorsatum* Zone of Soulatgé.

Discussion : An oxycone *Metatissotia* has the shell form of ***M. redtenbacheri***, but lacks sufficient sutural detail to confirm reference to de GROSSOUVRE's species.

Occurrence : PM B1. 1 is from the Upper Coniacian of the Corbières. The holotype of *M. redtenbacheri* is from the Assize L^1 of ARNAUD, tunnel de Laugerie, near Les Eyzies-de-Tayac (Dordogne), France, Middle Coniacian *tridorsatum* Zone.

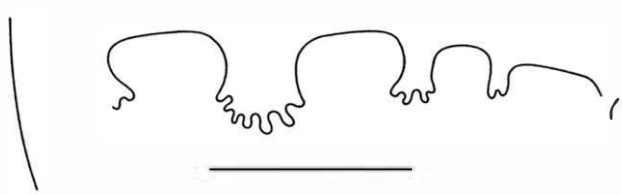

FIGURE 28

External suture of *Metatissotia ewaldi* (VON BUCH, 1848).
Sorbonne Collections, the original of de GROSSOUVRE 1894 (pl. 9, fig. 5) (see also Pl. 25, **fig. 12, 13**). Bar scale is 10 mm.

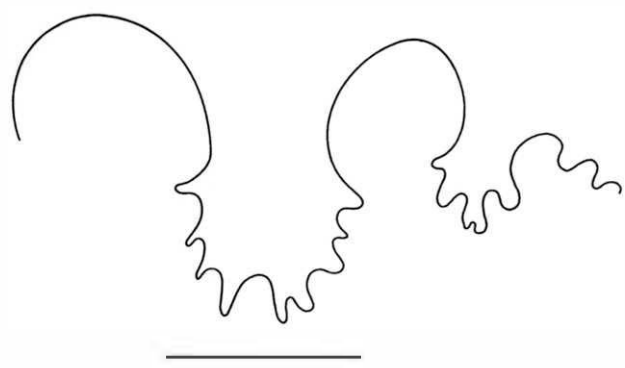

FIGURE 29

External suture of *Metatissotia sp.* 1.
UM SEN 027, the original of SÉNESSE, 1937 (pl. 11, fig. 4) from the Middle Coniacian *tridorsatum* Zone of Bugarach. Bar scale is 10 mm.

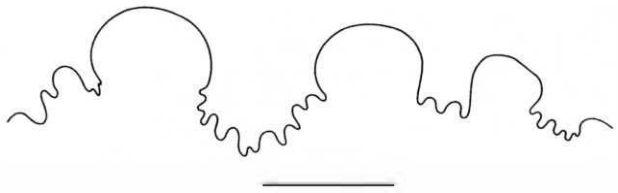

FIGURE 30

External Suture of *Metatissotia* sp. 2.
UM-SEN 029, the original of SÉNESSE 1937 (pl. 11, fig. 3) from the Middle Coniacian *tridorsatum* Zone of Bugarach.
Bar scale is 10 mm.

Family Sphenodiscidae HYATT, 1900
(= Libycoceratidae ZABORSKI, 1982 : p. 306)
Subfamily Lenticeratidae HYATT, 1900
(= Eulophoceratinae HYATT, 1903 : p. 83)
Genus *Paralenticeras* HYATT, 1900

Type species : *Amaltheus sieversi* GERHARDT, 1897 (p. 79, pl. 1, fig. 5).

Paralenticeras caneroti COLLIGNON, 1983
Pl. 25, fig. 8-10; Fig. 31

1983. *Paralenticeras caneroti* COLLIGNON (p. 204, pl. 7, fig. 3).

Type : Holotype is UPSTNB 20 (Pl. 25, fig. 8-10), from the Upper Santonian *paraplanum* Subzone Marnes Bleues de Sougraigne, on the 'chemin de Sougraigne aux Croutets'.

Description : The holotype consists of a wholly septate fragment and part of the body-chamber. The phragmocone fragment comprises just under half a whorl, with an estimated original diameter of 50 mm, a maximum preserved whorl height of 30.5 mm and whorl breadth-to-height ratio of 0.3. The shell is oxycone, with the greatest whorl breadth just outside the umbilical shoulder. The ventrolateral shoulder is marked by a distinct facet. There are suggestions of delicate prorsiradiate striae on the inner flanks, while the outer flanks bear short, widely separated faint, narrow ribs, an estimated six to eight per half whorl. The body-chamber extends to just over half a whorl, and may be complete. The whorl breadth-to-height ratio is 0.48, the shell stoutly oxycone with traces of a ventrolateral facet; there is no ornament on the mould. The juvenile suture shows a deeply incised trifid E/L with narrow-stemmed elements. The terminal suture appears to have had little incised auxiliary elements.

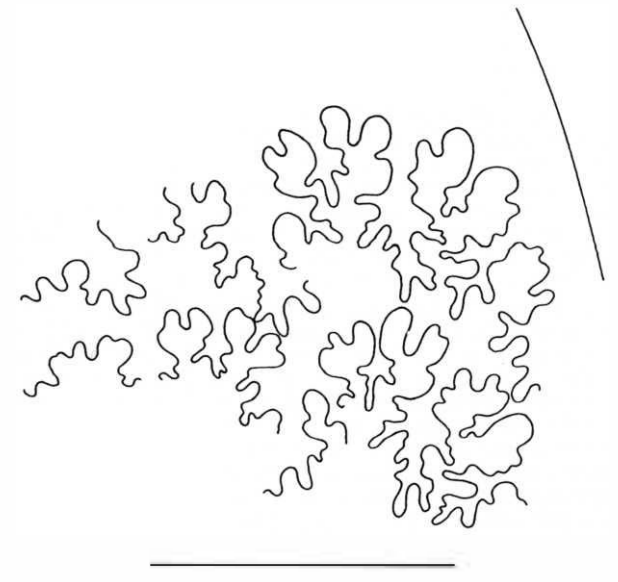

FIGURE 31

External suture of the inner whorls of the holotype of *Paralenticeras caneroti* COLLIGNON, 1983.
UPST NB 20, from the Upper Santonian *paraplanum* Subzone, Chemin de Sougraigne aux Croutets. Bar scale is 10 mm.

Discussion : *Paralenticeras* is typically Coniacian, but *P. caneroti* has the shell shape and suture of the type species, suggesting COLLIGNON's original generic assignation to be correct. WIEDMANN (1994) has, however recorded the closely allied genus *Lenticeras* from the Lower Santonian. *Paralenticeras sieversi* (GERHARDT, 1897) (see revision in RENZ, 1982 : p. 110, pl. 36, fig. 7-9; pl. 37, fig. 1; text-fig. 85a-d) has much stronger falcoid ornament of riblets and striae that persist to the adult body chamber. *P. leonhardianum* (KARSTEN, 1886) (p. 106, pl. 2, fig. 6) (see revision in RENZ, 1982 : p. 110, pl. 36, fig. 2-6; text-fig. 84) has weak to coarse, feebly falcoid branching ribs on the inner whorls. *P. spathi* REYMENT, 1958c (p. 17, pl. 1, fig. 6; pl. 2, fig. 5; pl. 3, fig. 2-4; pl. 4, fig. 1-4; text-fig. 6a-f, 7a-c; 8a-b, e-f) lacks the outer-flank ribs of the present species.

Occurrence : As for type.

Genus *Eulophoceras* HYATT, 1903
(= *Praelibycoceras* H. DOUVILLÉ, 1912 (p. 315);
Pelecodiscus VAN HOEPEN, 1921 (p. 30);
Sphenodiscoceras SPATH, 1921b (p. 243);
Skoumalia SUMMESBERGER, 1979 (p. 146)).

Type species : *Eulophoceras natalense* HYATT, 1903 (p. 86, pl. 11, fig. 2-6) by original designation.

Eulophoceras cf. *natalense* HYATT, 1903
Pl. 26, fig. 3, 4, 7; Fig. 32

compare :
1903. *Eulophoceras natalense* HYATT (p. 86, pl. 11, fig. 2-6).
1982. *Eulophoceras natalense* HYATT, 1903; IMMEL, KLINGER & WIEDMANN (p. 24, pl. 8, fig. 5).

Dimensions :	*D*	*Wb*	*Wh*	*Wb:Wh*	*U*
SP unregistered	63.5 (100)	21.8 (34.3)	45.5 (71.6)	0.48	– (–)

Description : The best-preserved specimen is a crushed juvenile 63.5 mm in diameter (Pl. 26, fig. 3, 4). Coiling is very involute, the shell oxycone, with a tiny umbilicus. Low, blunt, straight, prorsiradiate primary ribs arise in pairs at the umbilical seam and sweep

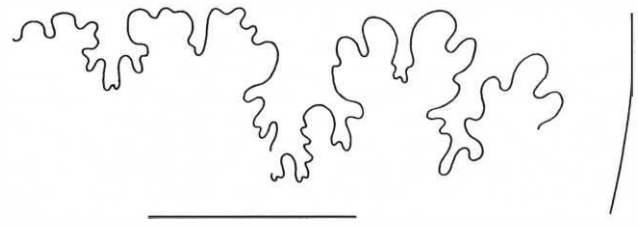

FIGURE 32

External suture of *Eulophoceras* cf. *natalense* HYATT, 1903.
UPST, L14, from the Santonian Marnes à *Micraster*, chemin de Montferrand. Bar scale is 10 mm.

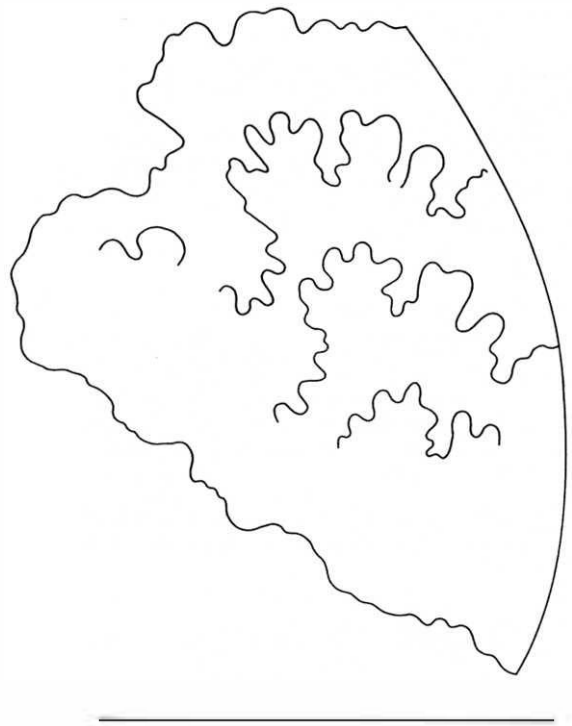

FIGURE 33

External suture of *Eulophoceras austriacum* (SUMMESBERGER, 1979). UPST MB, from the Upper Santonian pyritic *paraplanum* Subzone fauna of La Jouane.

forwards to mid-flank, where they flex back and are feebly concave and markedly rursiradiate on the outermost flank. There are a total of seven ribs on the first half of the outer whorl; the ribs decline markedly on the second half. UPST L14 (Pl. 26, fig. 7) is equally crushed, with an estimated original diameter of 65 mm. It has an estimated eight primary ribs on the last half whorl, arising in pairs at the umbilical shoulder, and much blunter and coarser than in the previous specimen.

Discussion : As noted by COOPER (1988), no less than nine *Eulophoceras* species are described from a limited Upper Santonian – Lower Campanian interval in Pondoland (South Africa), all probably conspecific, for which *natalense* is the earliest available specific name. The Corbières specimens have the same basic style of ribbing as this material and are probably conspecific.

Occurrence : Santonian of the Corbières.

Eulophoceras spp. juv.
Pl. 25, fig. 1, 2, 6, 7

1983. *Eulophoceras* cf. *miloni* HOURCQ; COLLIGNON (p. 205, pl. 7, fig. 4).
1983. *Eulophoceras grossouvrei* (COLLIGNON) (p. 205, pl. 7, fig. 4).

Discussion : COLLIGNON (1983) described two juvenile *Eulophoceras* from the Corbières that are too small to be usefully compared with the type material of the better-known African and Madagascan species. His *Eulophoceras* cf. *miloni* HOURCQ (Pl. 25, fig. 6, 7) is a limonitic phragmocone 45 mm in diameter, with delicate umbilical bullae and traces of falcoid ribs, most conspicuous on the outermost flank. It may be a juvenile of the *natalense* group, but is too small to be certain. The holotype of *Eulophoceras grossouvrei* COLLIGNON, 1983 (Pl. 25, fig. 1, 2) is a very corroded phragmocone 54 mm in diameter, without ornament in the limited areas where the surface of the mould survives undamaged. It is best regarded as a *nomen dubium*.

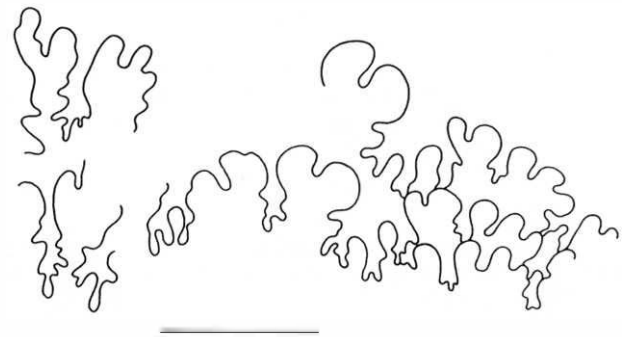

FIGURE 34

External suture of *Eulophoceras austriacum* (SUMMESBERGER, 1979). UPST A9-3. Upper Santonian *paraplanum* Subzone, Chemin de Sougraigne aux Croutets. Bar scale is 10 mm.

Occurrence : UPST S8, the original of *Eulophoceras* cf. *miloni* HOURCQ of COLLIGNON (1983) is from the Middle Santonian *gallicus* Zone. UPST 41, the holotype of *Eulophoceras grossouvrei* COLLIGNON, 1983, is from the Upper Santonian *paraplanum* Zone in the Corbières.

Eulophoceras austriacum (SUMMESBERGER, 1979)
Pl 25, fig. 3-5; Pl. 26, fig. 8; Fig. 33, 34

1979. *Skoumalia austriaca* SUMMESBERGER (p. 141, pl. 9, fig. 37-41; text fig. 26-30).
1980. *Skoumalia austriaca* SUMMESBERGER; SUMMESBERGER (p. 280, pl. 2, fig. 5, 6; pl. 3, fig. 7, 8; text-fig. 5, 6).
1985. *Eulophoceras austriaca* (SUMMESBERGER); AMÉDRO & HANCOCK (p. 23, fig. 11d, e).
1987. *Eulophoceras austriacum* (SUMMESBERGER, 1979); KENNEDY (p. 776, pl. 82, fig. 1-3).

Holotype : The original of SUMMESBERGER, 1979 (pl. 9, fig. 37, 38) from the Upper Santonian of the Gosau Basin, Austria.

Description : There are three specimens from the Corbières : two pyritic juveniles (Pl. 25, fig. 3-5) and a crushed adult (Pl. 26, fig. 8). The pyritic juveniles have whorl heights of up to 11 mm, corresponding to a diameter of 22 mm. Coiling is very involute, the umbilicus small (10 % of diameter), of moderate depth with a flattened wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with the greatest breadth at the umbilical shoulder, the flanks convergent, with a marked ventrolateral facet and an acutely fastigiate venter with entire keel. The whorl breadth-to-height ratio is 0.64. There are seven to eight umbilical bullae per whorl. They strengthen progressively as size increases, and give rise to groups of two or three low, broad prorsiradiate ribs which, together with occasional intercalated ribs, terminate in feeble ventrolateral bullae, an estimated 24 per whorl. The suture line of these juveniles shows a very broad, subtrifid E/L, with plump, entire to little-incised auxiliary elements (Fig. 33, 34). The adult specimen referred to the species (Pl. 26, fig. 8) is deformed into an ellipse with a major diameter of 150 mm. Coiling is very involute, oxycone; ornament is poorly preserved, but there are five to six low, broad, prorsiradiate inner flank ribs per whorl, and more numerous outer-lateral/ventrolateral bullae, connected tenuously to the inner-flank ribs in some cases. There is a feeble ventrolateral facet. The suture has a deeply incised E/L and a series of bifid auxiliary elements.

Discussion : The adult specimen differs in no significant respects from the Austrian type material. The juveniles closely resemble adult *Diaziceras* SPATH, 1921.

Occurrence : Upper Santonian of Austria and northern Aquitaine. Upper Santonian *paraplanum* Zone in the Corbières.

Suborder Ancyloceratina Wiedmann, 1966
Superfamily Turrilitaceae Gill, 1871
Family Anisoceratidae Hyatt, 1900
(= Algeritidae Spath, 1925b (p. 190);
Phlycticrioceratinae Spath, 1926 (p. 80))
Genus *Allocrioceras* Spath, 1926

Type species : By original designation : *Crioceras ellipticum* Woods, 1896 (p. 84 (*non* Mantell)) which was renamed *Allocrioceras woodsi* Spath, 1939 (p. 598) = *Hamites angustus* J. de C. Sowerby, 1850 (p. 346, pl. 29, fig. 12).

Allocrioceras aff. *burckhardti* Kennedy & Cobban, 1991a
Pl. 27, fig. 18, 19

compare :
1919. *Crioceras* sp. ind. (various forms) Burckhardt (p. 98 (*pars*), pl. 24, fig. 1, 2).
1991a. *Allocrioceras burckhardti* Kennedy & Cobban (p. 58, pl. 10, fig. 14, 16).

Description : The single fragment PM B5-39 is 42.5 mm long, with a maximum preserved whorl height of 20.5 mm, the whorl section very compressed, apparently a result of *post-mortem* crushing. The rib index is seven, the ribs coarse, prorsiradiate, feebly convex on the flanks, and all bearing a strong ventrolateral tubercle, linked by a single transverse rib across the venter to the tubercle on the opposite flank.

Discussion : Ornament of this short fragment closely resembles that of *A. burckhardti*, but the whorl section is very compressed rather than subcircular, and there are no constrictions. To what extent this is a matter of preservation cannot be established.

Occurrence : *Allocrioceras* aff. *burckhardti* occurs in the Middle Santonian *gallicus* Subzone in the Corbières. *A. burckhardti* is known from the Middle Coniacian of Montana, the Upper Coniacian of Utah and the undifferentiated Coniacian of Guerro Province, Mexico.

Genus *Phlycticrioceras* Spath, 1926

Type species : *Ancyloceras* (?) *douvillei* de Grossouvre, 1894 (p. 254, pl. 35, fig. 8) = *Hamites trinodosus* Geinitz, 1850 (p. 18, pl. 3, fig. 4) by original designation.

Phlycticrioceras rude sp. nov.
Pl. 19, fig. 3, 4

Type : Holotype is PM E8-2, from the Upper Santonian *paraplanum* Subzone Calcaires à *Lima marticensis* SW of Brenz, Corbières, Aude.

Description : Known from the holotype only, a curved fragment 83 mm long of which only the adapertural 63 mm are well preserved. The maximum preserved whorl height is 25 mm, the whorl section compressed, whorl breadth-to-height ratio 0.44, with flattened dorsum, narrowly rounded dorsolateral margins, flat subparallel flanks and a narrowly rounder venter in intercostal section, the costal section fastigiate. The rib index is four. The fragment bears six primary and five short intercalated ribs, alternating irregularly, with up to two intercalated ribs between primaries and up to three successive primaries. The latter are weak to effaced on the dorsum, strengthening, sweeping back and feebly concave across the dorsolateral margin. They are coarse, straight and rursiradiate on the flanks, strengthening into coarse ventral tubercles, linked over the venter by a coarse rib with a blunt, poorly differentiated siphonal tubercle. Intercalated ribs arise high on the flank, and some lack ventral tubercles.

Discussion : The type species of *Phlycticrioceras*, *P. trinodosum* (Geinitz, 1850) is Upper Coniacian, and differs from *P. rude* in having numerous crowded primary ribs with sharp siphonal tubercles. Young (1963) recorded the species from the Santonian, and Clark (1963) from the Campanian, an unusually long and perhaps unlikely range for a heteromorph species.

Occurrence : As for type.

Family Nostoceratidae Hyatt, 1894
(= Jouaniceratidae Wright, 1952 (p. 218);
Bostrychoceratinae Spath, 1953 (p. 16);
Emperoceratinae Spath, 1953 (p. 17);
Hyphantoceratinae Spath, 1953 (p. 16))
Genus *Hyphantoceras* Hyatt, 1900

Type species : *Heteroceras roissyanum* Schlüter, error for *reussianum* d'Orbigny, 1850 (p. 215) by original designation by Hyatt, 1900 (p. 587).

Hyphantoceras plicatum (d'Orbigny, 1842)
Pl. 28, fig. 20-23

1842. *Turrilites plicatus* d'Orbigny (p. 592, pl. 143, fig. 7, 8).
1876. *Turrilites plicatus* d'Orbigny; Schlüter (p. 137, pl. 36, fig. 6, 7).
1925. *Turrilites plicatus* d'Orbigny; Diener (p. 84).
1955c. *Turrilites plicatus* d'Orbigny; Sornay (fiche 7, 3 fig).
? 1987. *Hyphantoceras* (*Hyphantoceras*) *orientaliforme* Immel (p. 133, pl. 14, fig. 1).
1994. *Hyphantoceras plicatum* (d'Orbigny, 1842); Kaplan & Kennedy (p. 54, pl. 37, fig. 7, 8).

Type : The holotype, by monotypy, is the original of d'Orbigny, 1842 (pl. 143, fig. 7, 8) no R1196 in the collections of the Muséum National d'Histoire Naturelle, Paris, from Soulatgé, Aude, France, refigured by Sornay (1955c : fig. 1) (Pl. 28, fig. 21, 22).

Description : The holotype **(Pl. 28, fig. 21, 22)** is a fragment of less than two whorls with a combined height of 31.5 mm, coiled in a loose helix, the whorls seemingly not in contact. Ornament on the outer, upper whorl face is of delicate narrow concave ribs, separated by somewhat wider interspaces. The ribs strengthen into delicate, long, transversely elongate tubercles at the junction of the upper and outer whorl faces. These are connected by single delicate, straight prorsiradiate ribs to a second delicate tubercle low on the outer whorl face. A narrow spiral impressed zone separates this second row of tubercles from a third row of small, slightly transversely-elongated tubercles at the juncture of outer and lower whorl faces, linked to the supradjacent row by a single rib. The ribs sweep back and are convex on the lower whorl face.

Discussion : This is a very rare species. Schlüter (1876 : p. 137, pl. 36, fig. 6, 7) **(Pl. 28, fig. 20, 23)** figured two specimens with the same narrow, wiry ribs and delicate tubercles from the Coniacian of the Münster Basin, Germany.

Occurrence : The holotype is from 'Soulatgè'; the species also occurs in the Coniacian of the Münster Basin, Germany.

Hyphantoceras aff. *plicatum* (d'Orbigny, 1842)
Pl. 27, fig. 22

Discussion : PM K4A2 **(Pl. 27, fig. 22)** consists of three whorls of a helix 23.5 mm in total height with a maximum preserved whorl height of 9 mm, and represents a *Hyphantoceras* allied to *H. plicatum*, but differing in several important respects : pairs of ribs link the upper-whorl suture to the upper row of tubercles and

intercalate between, and tubercles of the upper row are much coarser than those in the lower two rows.

Occurrence : Middle Santonian *gallicus* Subzone of the Corbières.

Hyphantoceras (?) *amapondense* (Van Hoepen, 1921)
Pl. 28, fig. 24-30

1921. *Heteroceras amapondense* Van Hoepen (p. 17, pl. 4, fig. 1, 2).
1983. *Hyphantoceras amapondense* (Van Hoepen); Lewy (p. 24, fig. 1-6 (with synonymy)).
1985. *Hyphantoceras* (? *Madagascarites*) *amapondense* (Van Hoepen, 1921); Klinger (p. 6, fig. 4I-4K).
1991b. *Hyphanthoceras* (?) *amapondense* (Van Hoepen, 1921); Kennedy & Cobban (p. 181, fig. 9 :9, 10).

Type : Holotype by original designation is the original of Van Hoepen 1921 (pl. 4, fig. 1, 2) from the Santonian – Campanian Umzamba Formation of Umzamba, Transkei, South Africa. The original is housed in the Collections of the South African Museum, Cape Town.

Description : Numerous mainly fragmentary specimens are referred to this species. Low helices are up to 37 mm in diameter. The whorl section is circular, the ribs sharp, narrow, periodically flared, and there are occasional constrictions. Larger, body-chamber fragments show irregular coiling, with periodic very strongly flared ribs, with up to four much weaker ribs between.

Occurrence : Middle and lower Upper Santonian, *gallicus* Subzone and lower *paraplanum* Subzone in the Corbières. Elsewhere, the species is known from the Upper Santonian or Lower Campanian of Zululand and Pondoland, South Africa, Upper Santonian of Mississippi, Israel and Austria, and Lower Campanian of Madagascar.

Genus *Tridenticeras* Wiedmann, 1962

Type species : *Turrilites tridens* Schlüter, 1872a (p. 136, pl. 35, fig. 9, pl. 36, fig. 1) by original designation.

Tridenticeras varians (Schluter, 1872)
Pl. 27, fig. 10, 11, 12, 20, 21, 23

1872. *Turrilites varians* Schlüter (pl. 35, fig. 11-13).
1876. *Turrilites varians* Schlüter (p. 137, pl. 36, fig. 2, 5).
1994. *Tridenticeras varians* (Schlüter, 1872); Kaplan & Kennedy (p. 54, pl. 38, fig. 1, 2, 4-7; pl. 42, fig. 1-3).

Types : Lectotype is GPIB 78c, the original of Schlüter, 1876 (pl. 36, fig. 2, 3) designated by Kaplan & Kennedy, 1994 (p. 56); parelectotype GPIB 78a is the original (pl. 35, fig. 11); paralectotype GPIB 78b is the original (pl. 35, fig. 12, 13). All are from the 'Mergeln von Stoppenberg bei Essen'. The original of Schlüter's (pl. 36, fig. 4, 5) has not been traced.

Description : Paralectotype GPIB 78b is a crushed fragment 26 mm long. Ornament is of fine wiry ribs, prorsiradiate on the outer, exposed whorl face. Traces of three rows of tubercles are present, one just outside the inter-whorl suture at the top of the outer, exposed whorl face, linked by two to three looped ribs to a second, larger row close to mid-flank, in turn linked by two to three looped ribs to the third row, at the juncture of the outer and lower whorl faces. There are up to four nontuberculate ribs between. The lower whorl face is ornamented by somewhat coarser straight ribs only. Ribs are weakened markedly on the inner whorl face. Paralectotype GPIB 78a is a larger fragment, again badly crushed, and 54 mm long. It shows three rows of coarse tubercles, the lowest markedly spinose, linked by groups of two to three ribs with three ribs intercalating between. The lectotype, GPIB 78c consists of a crushed spire 38 mm high, with two complete whorls preserved. Ornament on the first half whorl corresponds to that of the paralectotypes, but it modifies markedly beyond this, on what is interpreted as the adult body-chamber. The uniformly fine and wiry ribs differentiate into weak and strong, leading to a final whorl ornamented by distant, narrow, flared ribs with delicate riblets between, the ribs concave on the upper part of the exposed whorl face, strongly prorsiradiate on the outer part, swept back across the juncture of outer and lower whorl faces, and markedly concave on the latter. The major ribs initially bear traces of the three rows of tubercles, but these are rapidly lost. This specimen is interpreted as an adult microconch. The much larger individual showing similar ontogenetic changes illustrated by Schlüter (1876 : pl. 36, fig. 4, 5) is lost, and appears to represent the macroconch of the species. There are seven specimens from the Corbières; these differ from the type material only in their better preservation; both macroconch (Pl. 27 fig. 10) and microconch (Pl. 27, fig. 11, 20, 21) individuals can be recognized.

Discussion : *Tridenticeras varians* can be distinguished from *T. tridens* by its coarser ribbing and the presence of only three rows of tubercles. *Tridenticeras undosum* (Schlüter, 1876) (p. 138, pl. 36, fig. 9) lacks tubercles and has strong ribs separated by pairs of much weaker ones.

Occurrence : Upper Middle Coniacian upper *tridorsatum* Zone and Upper Coniacian *margae* Zone in the Corbières. The types and other German material are from the Upper Coniacian *Paratexanites serratomarginatus* Zone of the Münster Basin.

Genus *Eubostrychoceras* Matsumoto, 1967

Type species : *Eubostrychoceras indopacificum* Matsumoto, 1967 (p. 33, pl. 18, fig. 1) by original designation.

Eubostrychoceras saxonicum (Schluter, 1875)

1872b. *Turrilites geinitzii* d'Orbigny; Schluter (p. 113, pl. 35, fig. 10).
1875. *Turrilites saxonicus* Schlüter (p. 30).
1876. *Turrilites saxonicus* Schlüter; Schlüter (p. 135).
1965a. *Bostrychoceras saxonicum* Schluter; Collignon (p. 10, pl. 417, fig. 1724).
1979. *Didymoceras saxonicum* (Schlüter); Wright (p. 296, pl. 2, fig. 8-12; pl. 7, fig. 5 (with additional synonymy)).
1988. *Eubostrychoceras saxonicum* (Schlüter); Kaplan & Schmid (p. 50, pl. 1, fig. 1-3; pl. 2, fig. 1-6; pl. 3, fig. 1-3 (with additional synonymy)).

Lectotype : Designated by Kaplan & Schmid, 1988 (p. 50) is the original of Geinitz, 1840 (pl. 13, fig. 1).

Discussion : A single fragment, PM PN VIII consists of parts of two whorls of a closely coiled *Eubostrychoceras* with a maximum preserved whorl height of 28 mm. The outer and lower whorl faces are strongly convex. Ornament is of dense, fine, narrow, feebly prorsiradiate, feebly flexuous ribs that join in pairs close to the umbilicus on the lower whorl face.

Occurrence : Upper Turonian and Lower Coniacian. The Corbières specimen is from the Lower Coniacian *F. (H.) petrocoriensis* Zone of Peyrefitte. The species has a geographic distribution from southern England to northern France, Germany, Poland, the Czech Republic, Japan and Madagascar.

Eubostrychoceras acuticostatum (d'Orbigny, 1842)
Pl. 28, fig. 9, 31, 32

1842. *Turrilites acuticostatus* d'Orbigny (p. 605, pl. 147, fig. 3, 4).
1925. *Turrilites acuticostatus* d'Orbigny; Diener (p. 79).

1955b. *Turrilites* (*Bostrychoceras*) *acuticostatus* d'Orbigny; Sornay (Fiche 6, fig. 1-3).

Type Holotype, by monotypy, is MNHP R1193 (ex d'Orbigny Collection no. 7210), from the environs of Soulatgé (Aude).

Description : The holotype (Pl. 28, fig. 9) is a composite mould, part of a crushed helix 42 mm in diameter. The upper whorl face is feebly convex, the outer and lower whorl faces broadly rounded. Ornament is of sharp, narrow ribs, of which 17 survive on the fragment. They sweep back across the upper whorl face, then flex forwards and are concave across the juncture of upper and outer, exposed whorl faces, sweep forwards and are markedly oblique on the outer whorl face, where they strengthen markedly, sweep back and are convex across the juncture of outer and lower whorl faces. They are strong and feebly convex on the lower whorl face. A better-preserved fragment G5C4 (Pl 28, fig. 31, 32) shows the sharpness of the ribbing to advantage, and their single nature.

Discussion : Loose coiling, low expansion rate and narrow, sharp, distant ribs suggest these fragments to be a *Eubostrychoceras*, the ornament immediately distinct from that of *E. saxonicum*. The closest species is *Eubostrychoceras matsumotoi* Cobban, 1990, from the Turonian of the U.S. Western Interior, but this is even more coarsely ribbed.

Occurrence : Middle Santonian *gallicus* Subzone of the Corbières.

Genus *Jouaniceras* Basse, 1939

Type species : *Heteroceras* (?) *sicardi* de Grossouvre, 1894 (p. 223, pl. 37, fig. 6, 11) by original designation by Basse, 1939 (p. 43).

Jouaniceras sicardi (de Grossouvre, 1894)
Pl. 28, fig. 1-8, 10-19; Fig. 35

1894. *Lytoceras Sicardi* de Grossouvre (p. 223, pl. 37, fig. 6, 11).
1894. *Heteroceras* (?) *Sicardi* de Grossouvre (p. 224, footnote).
1925. *Lytoceras Siccardi* Grossouvre; Diener (p. 46).
? 1920. *Heteroceras* (?) cf. *Sicardi* de Grossouvre; Desio (p. 233(45), pl. 16(5), fig. 5 on plate; 3 in explanation and text).
1939. *Lytoceras* (*Jouaniceras*) *Sicardi* de Grossouvre; Basse (p. 43, pl. 3 fig. 3-7; p. 42, text fig. 1).
1957. *Jouaniceras sicardi* (Gross.); Wright (p. L224, fig. 225, 4a-c).
1980. *Jouaniceras siccardi* de Grossouvre; Thomel (p. 61, fig. 106).
1983. *Jouaniceras sicardi* (de Grossouvre); Collignon (p. 185).

Types : Holotype, by original designation is the original of de Grossouvre, 1894 (pl. 37, fig. 11) from the 'Marnes bleues comprises entre deux bancs à *Hippurites cornucopiae*. Environs de Sougraigne (Aude)'; the specimen has not been traced. Paratype MNHP R1194 is the original of de Grossouvre, 1894 (pl. 37, fig. 6) (Pl. 28, fig. 1). It is from the 'Marnes ferrugineuses à *Placenticeras syrtale*, comprises entre les deux bancs inférieurs de rudistes du chemin de Sougraigne aux Croutets (Aude)'.

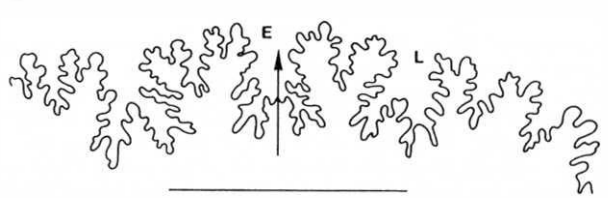

Figure 35

External suture of *Jouaniceras sicardi* (de Grossouvre, 1894). UM SEN 036, the original of Basse, 1939 (pl. 3, fig. 3) from the Upper Santonian pyritic *paraplanum* Subzone fauna of La Jouane. Bar scale is 10 mm.

Description : We have more than one hundred specimens, the great majority pyritic nuclei. The earliest preserved growth-stage consists of a small helix, the most complete of which have up to three preserved whorls (Pl. 28, fig. 2-7, 12, 13), the whorls of internal moulds seemingly not in contact, and without an impressed zone on the upper whorl face to accommodate the previous whorl. Ornament is of distant ribs, 20 per whorl, coarse and transverse on the upper whorl face, effaced and markedly rursiradiate on the outer, exposed whorl face, and strengthened on the lower whorl face. A pronounced constriction (Pl. 28, fig. 2, 3) may separate this stage from the second, planispiral stage which extends for up to two phragmocone whorls (Pl. 28, fig. 12, 14-16). The whorl section is subcircular with a pronounced dorsal, impressed zone, the whorls in contact. There are generally 25-30 ribs on the second planispiral whorl, but more on the initial planispiral whorl. The ribs are coarse, feebly prorsiradiate, and straight to feebly convex on the flanks and transverse on the venter, being typically flat-topped on internal moulds (Pl. 28, fig. 10-13) but sharp where shell is preserved (Pl. 28, fig. 14-16, although this specimen is partially exfoliated). Phragmocones with up to two whorls vary widely in size (Pl. 28, fig. 12, 14-16) to a maximum diameter of 26.5 mm. The only known well-preserved body-chamber extends to 120° and has a maximum preserved whorl height of 9 mm, the whorl section slightly depressed oval, with a shallow impressed dorsal concavity. Five narrow, sharp, high ribs are flared markedly on the flanks, and separated by up to three ribs, the adapertural are the stronger, the adapical one(s) much weaker. Ornament is near-effaced on the dorsum, where the ribs are feebly convex, and strong and transverse on the venter, although not as strong as the flared lateral regions of the main ribs. Suture (Fig. 35) with deeply incised bifid elements.

Discussion : Wiedmann (1994 : p. 232, pl. 43, fig. 1, 2; text-fig. 16a) recognised a second *Jouaniceras* species, *J. hispanicum*, from the Middle Santonian of northern Spain. It was described as being a larger species (which it is not), having much denser ribbing (42 ribs per whorl versus 30 in *J. sicardi* at a similar growth stage), the even ribbing extending onto an uncoiled body-chamber. The *Heteroceras* (?) cf. *Sicardi* of Desio (1920 : p. 233(45), pl. 16(5), fig. 5 on plate 3, in plate explanation and text) from the Upper Cretaceous near Florence has widely separated sharp, narrow, and seemingly even ribs on the body chamber.

Occurrence : Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones in the Corbières.

Family Diplomoceratidae Spath, 1926
Subfamily Diplomoceratinae Spath, 1926
Genus *Glyptoxoceras* Spath, 1925a

Type species : *Hamites rugatus* Forbes, 1846 (p. 117) by original designation by Spath, 1925a (p. 30).

Glyptoxoceras souqueti Collignon, 1983
Pl. 29, fig. 12-18; Fig. 36

1983. *Glyptoxoceras souqueti* Collignon (p. 186, pl. 1, fig. 4).

Type : Holotype, by original designation, is UPST MB 24, refigured here as Plate 29, figures 14, 15, from the Upper Santonian paraplanum Subzone, 'chemin de Sougraigne aux Croutets'.

Description : The holotype consists of more than 270° of an irregular elliptical coil of body-chamber with a maximum preserved whorl height of 21.5 mm. The whorl section is slightly compressed, ovoid, with a whorl breadth-to-height ratio of 0.88, the dorsum more broadly rounded than the venter. The rib index varies from five to six, the ribs much narrower than the interspaces, sharp, weak and transverse to feebly convex across the dorsum, strengthened, straight to feebly convex and markedly rursiradiate across the flanks and strong and transverse across the venter. Occasional fragments may be constricted (Pl. 29, fig. 12, 13).

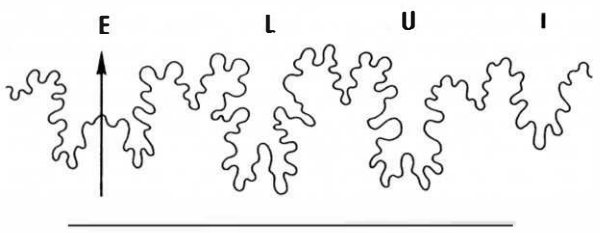

FIGURE 36

Suture of *Glyptoxoceras souqueti* COLLIGNON, 1983.
UM SEN 038, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. Bar scale is 10 mm.

Discussion : *Glyptoxoceras crispatum* (MOBERG, 1885) (p. 32, pl. 3, fig. 12, 13; see below) from the Santonian of southern Sweden is a very close ally of the present species. The type material differs from *G. souqueti* in having a higher rib-index, the ribs feebly convex on the phragmocone, less so on the adapical body-chamber, and near-transverse, straight and feebly rursiradiate at the adapertural end. The two may be no more than variants of the same species, but material referred to *G. crispatum* below has much finer, straight ribbing suggesting separation may be possible. The Lower and lower Upper Campanian *Glyptoxoceras aquisgranense* (SCHLÜTER, 1872) (p. 102, pl. 31, fig. 6-9); KENNEDY, HANSOTTE, BILOTTE & BURNETT, 1992 (p. 274, pl. 1, fig. 6, 7, 11, 12, 14-19; pl. 2, fig. 1-5, 9-15; pl. 3, fig. 1-9) has a complex coiling ontogeny, and at the size represented by *G. souqueti* a circular to elliptical coil with a rib index of up to nine, but decreasing to five or six on some body-chambers, the ribs rursiradiate, straight on the dorsal flank, but flexed forwards in many specimens and feebly concave on the ventral part of the flank. *Glyptoxoceras retrorsum* (SCHLÜTER, 1872) from the Upper Campanian (see KENNEDY, 1986a : text-fig. 38A-D) has ribs that are feebly concave on the outer flank in small fragments; larger ones suggest an elliptical or circular coil.

Occurrence : Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones in the Corbières.

Glyptoxoceras crispatum (MOBERG, 1885)
Pl. 27, fig. 16, 24; Pl. 29, fig. 1, 8, 11, 19, 20

1885. *Anisoceras* (*Hamites*) *crispatus* MOBERG (p. 32, pl. 3, fig. 12, 13).
1982. *Diplomoceras* (*Glyptoxoceras*) *subcompressum* (FORBES, 1846); IMMEL, KLINGER & WIEDMANN (p. 26 (*pars*), pl. 9, fig. 4, 5; *non* pl. 10, fig. 7; pl. 11, fig. 4 (*non* FORBES)).
1982. *Diplomoceras* (*Glyptoxoceras*) *indicum* (FORBES, 1846); IMMEL, KLINGER & WIEDMANN (p. 26, pl. 10, fig. 5, 6).

Types : A series of fragments, including those figured by MOBERG, in the type collections of the Geological Survey of Sweden, and from the Santonian of Eriksdal, Sweden.

Description : The best-preserved of MOBERG's syntypes (1885 : pl. 13, fig. 12) is a crushed, partially septate, composite mould 77 mm long and gently curved, with a maximum preserved whorl height of 18 mm. The rib index is eight, the ribs narrow, sharp, feebly convex on the phragmocone, less so on the adapical body-chamber and near-transverse, straight, and feebly rursiradiate at the adapical end. Near-complete specimens from the Corbières are hamitid in coiling (Pl. 29, fig. 11, 19, 20) and smaller, curved specimens (Pl. 27, fig. 16, 24) are assumed to represent an initial open coiled stage. These coiled fragments have narrow, sharp, prorsiradiate straight to feebly concave ribs, with a rib index of 7-8. Large specimens have a rib index of 8-9, the ribs straight and transverse to feebly rursiradiate. They become markedly rursiradiate and curved around the final hook, and are straight and feebly rursiradiate to rectiradiate on the final shaft. The presence of large (Pl. 29, fig. 20) and small (Pl. 29, fig. 11, 19) body-chambers suggests poorly defined dimorphism.

Discussion : Differences from other European *Glyptoxoceras* are outlined above, under *G. souqueti*. IMMEL *et al.* (1982) described a series of *Glyptoxoceras* fragments from the Lower Santonian of Brandenberg/Tirol, Austria which they assigned to taxa originally described from the Upper Maastrichtian of Pondicherry, South India. It is unlikely that they represent these taxa, and they can better be compared with contemporaneous *G. crispatum*.

Occurrence : The types are from the Lower Santonian of Eriksdal, Sweden. Lower and Middle Santonian, *carezi* and *gallicus* Subzones in the Corbières. The Gosau occurrences are regarded as Lower Santonian by IMMEL *et al.* (1982).

Genus and subgenus *Neocrioceras* SPATH, 1921
Neocrioceras (*Neocrioceras*) sp. juv ?
Pl. 28, fig. 33

Discussion : A 13 mm long fragment with a maximum preserved whorl height of 5.5 mm has a circular whorl section. Ornament consists of small, sharp lateral and ventral tubercles linked by pairs of narrow, looped ribs, with single delicate annular ribs between. The ornament is slightly asymmetric on the venter, but whether this reflects an original helical mode of coiling or *post-mortem* deformation is unclear. The ornament style is that of *Neocrioceras* (*Neocrioceras*), as shown by early growth stages of the type species (MATSUMOTO, 1985 (text-fig. 1, 2); MATSUMOTO *et al.*, 1986 (pl. 94, fig. 1-16)).

Occurrence : Middle Santonian *gallicus* Subzone in the Corbières.

Subgenus *Schlueterella* WIEDMANN, 1962

Type species : *Ancyloceras pseudoarmatum* SCHLUTER, 1872 (p. 99, pl. 31, fig. 1-3) by original designation, by WIEDMANN, 1962 (p. 205).

Neocrioceras (*Schlueterella*) *compressum* KLINGER, 1976
Pl. 27, fig. 13-15, 17; Pl. 29, fig. 4-7

1976. *Neocrioceras* (*Schlueterella*) *compressum* KLINGER (p. 74, pl. 33, fig. 5; text-fig. 8j, 10g).
1982. *Neocrioceras* (*Schlueterella*) *compressum* KLINGER, 1976; IMMEL, KLINGER & WIEDMANN (p. 25, pl. 9, fig. 3; pl. 10, fig. 1-4; pl. 11, fig. 3).
1991a. *Neocrioceras* (*Schlueterella*) *compressum* KLINGER, 1976; KENNEDY & COBBAN (p. 65, pl. 10, fig. 1, 2; pl. 12, fig. 4-7; text-fig. 25c).

Type : Holotype by original designation is the original of KLINGER, 1976 (pl. 33, fig. 5) no H19/1 in the Collections of the South African Geological Survey, Pretoria, from the Santonian of Zululand, South Africa.

Description : Small, slightly curved fragments have whorl heights of up to 16.5 mm. The rib index is estimated at nine. Pairs of wiry ribs link across the venter at strong ventrolateral tubercles. These are linked in turn by a pair of looped ribs to a subequal to slightly weaker dorsolateral tubercle which in turn gives rise to a pair of ribs that extends across the dorsum. There are two or three wiry ribs between the tuberculate groups; these are feebly prorsiradiate and feebly convex. Larger fragments have whorl heights of up to 27.5 mm (Pl. 27, fig. 13, 14); even larger fragments have suffered dorsolateral crushing and original whorl height cannot be determined. The rib index is up to 12. Ribs are transverse on the venter (Pl. 27, fig. 15, 17), most ribs looping in pairs between subspinose ventral tubercles, with up to three intercalated ribs between. There

is a similar pattern of ornament on the flank, with pairs of ribs linking to subspinose dorsolateral tubercles with nontuberculate ribs between.

Discussion : *N.* (*S.*) *compressum* may be distinguished from the type species *N.* (*S.*) *pseudoarmatum* (Schlüter, 1872) (p. 99, pl. 31, fig. 1-3) on the basis of its smaller size, finer ornamentation, and more numerous nontuberculate ribs that are more pronouncedly looped on the flanks.

Occurrence : Santonian of Zululand and Brandenberg/Tirol, Austria; Middle Coniacian of Wyoming in the U.S. Western Interior. In the Corbières the species occurs in the Middle Santonian *gallicus* Subzone.

Subfamily Polyptychoceratinae Matsumoto, 1938 (*nom. transl.* Wiedmann, 1962 (p. 185) *ex* Polyptychoceratidae Matsumoto) Genus and subgenus *Pseudoxybeloceras* Wright & Matsumoto, 1954

Type species : *Hamites quadrinodosus* Jimbo, 1894 (p. 185(39), pl. 23(7), fig. 3, 4) by original designation.

Pseudoxybeloceras (*Pseudoxybeloceras*) sp. Pl. 29, fig. 9

Description : PM KO-1.20 is a short curved fragment of heteromorph 32 mm long, with a maximum preserved whorl height of 11 mm; the original whorl section and proportions cannot be determined. The rib index is seven on the ventral part of the flanks. The main ribs are narrow, straight and prorsiradiate on the dorsal flanks, and all bear a bullate inner ventrolateral tubercle. A broadened, prorsiradiate rib links to a subspinose outer ventrolateral tubercle linked to the corresponding tubercle on the other side of the venter by a narrow transverse rib. A curious feature of the fragment is the presence of occasional intercalated dorsolateral ribs.

Discussion : Ribbing and tuberculation suggest this specimen is a juvenile *Pseudoxybeloceras* (*Pseudoxybeloceras*). The disposition of tubercles recalls that of the much larger holotype of *P.* (*P.*) *matsumotoi* Collignon, 1965 (p. 12, pl. 419, fig. 1731) from the Coniacian of Madagascar, which has a similar disposition of ribs and tubercles, but the great disparity in size precludes closer comparison.

Occurrence : Middle or Upper Coniacian, *tridorsatum* or *margae* Zones of the Corbières.

Subgenus *Parasolenoceras* Collignon, 1969

Type species : *Parasolenoceras splendens* Collignon, 1969 (p. 44, pl. 530, fig. 2087, 2088) by original designation.

Pseudoxybeloceras (*Parasolenoceras*) aff. *splendens* Collignon, 1969 Pl. 29, fig. 2, 3

1983. *Neancyloceras* aff. *bipunctatum* (Schlüter); Collignon (p. 187, pl. 1, fig. 3).

Description : UPST S13 (Pl. 29, fig. 2, 3) is a body-chamber fragment 36 mm long, with a maximum preserved whorl height of 22 mm and whorl breadth-to-height ratio of 0.85 approximately, ovoid, the venter more narrowly rounded than the dorsum in intercostal section and flattened in costal section. The rib index is six, the ribs very weak and effaced on the flank and prorsiradiate. The ribs terminate in small, sharp, subspinose ventral tubercles, linked over the venter by a very feeble transverse rib.

Discussion : The fragment closely resembles the adapertural end of the body-chamber of the holotype of *Parasolenoceras splendens* (Collignon, 1969 : p. 44, pl. 530, fig. 2087, 2088) from the Lower Campanian of Madagascar, differing in the much more subdued and less regular ribbing.

Occurrence : Middle Santonian *gallicus* Subzone of the Corbières.

Family Baculitidae Gill, 1871 Genus *Baculites* Lamarck, 1799 (= *Homaloceratites* Hupsch, 1768 (p. 110) (*non binomen*); *Euhomaloceras* Spath, 1926 (p. 80))

Type species : *Baculites vertebralis* Lamarck, 1801 (p. 103) by subsequent designation by Meek, 1876 (p. 391).

Baculites spp. Pl. 27, fig. 1-9

Discussion : There are relatively few *Baculites* in the Corbières Collections, other than tiny pyritic fragments from localities such as La Jouane. Of larger specimens, nodeless individuals (Pl. 27, fig. 1-3) may be compared with *Baculites fuchsi* Redtenbacher, 1873 (p. 134, pl. 30, fig. 15); Summesberger, 1979 (p. 113, pl. 1, fig. 2, 3, 4; text-fig. 2, 3) otherwise known from the Santonian Gosau Formation of Austria. A large nodate individual (Pl. 27, fig. 4, 5) has dorsolateral tubercles elongated parallel to the length of the shell, and little other decoration. It closely resembles the *Baculites incurvatus* Dujardin of Müller & Wollemann, 1906 (pl. 2, fig. 1) from the Upper Santonian or Lower Campanian of Broitzem, Germany. A third individual (Pl. 27, fig. 6-9) combines circular dorsolateral nodes with strong concave growth striae on the flanks, as with a distinctive and as yet unnamed form from the Lower Campanian of the Aachen region (e.g. Van Der Weijden, 1943 : pl. 13, fig. 5).

Occurrence : In the Corbières, *Baculites* species occur in the Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones.

Genus *Boehmoceras* Riedel, 1931

Type species : *Ancyloceras krekeleri* Wegner, 1905 (p. 210, pl. 8, fig. 2) by the subsequent designation of Wright, 1957 (p. L220).

Boehmoceras krekeleri (Wegner, 1905) Pl. 30, fig. 37, 38, 41, 42; Fig. 37

1905. *Ancyloceras krekeleri* Wegner (p. 210, pl. 8, fig. 2).
1931. *Boehmoceras krekeleri* (Wegner); Riedel (p. 691, pl. 77, fig. 3-5; pl. 78, fig. 1, 2).
1979. *Boehmoceras krekeleri* (Wegner); Summesberger (p. 118, pl. 2, fig. 14, text-fig. 7, 8).
1985. *Boehmoceras krekeleri* (Wegner, 1905); Schönfeld (p. 33, pl. 2, fig. 4).
1987. *Boehmoceras krekeleri* (Wegner) Riedel, 1931; Kennedy, (text-fig. 3a, b).
1991. *Boehmoceras krekeleri* (Wegner, 1905); Kennedy & Christensen (p. 154, fig. 2d-h; 4c, d, h, j).

Type : Holotype is the original of Wegner, 1905 (p. 210, pl. 8, fig. 2) from the 'Recklinghauser Mergel auf Zeche Graf Waldersee bei 3 m Tiefe', in the western part of the Münster Basin, Germany.

Description : UPST L 1 (Pl. 30, fig. 37, 38, 41) is a 180° arcuate fragment 76 mm in diameter, most of which is body-chamber, with a maximum preserved whorl height of 24 mm and a whorl breadth-to-height ratio of 0.48, the dorsum flattened, dorsolateral margin

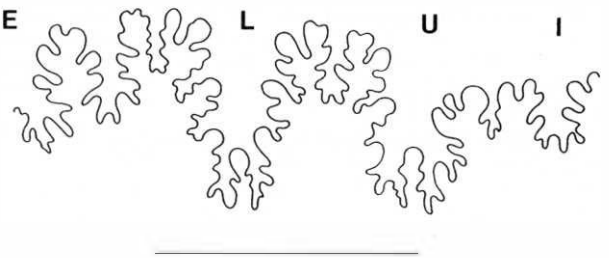

FIGURE 37
Suture of *Boehmoceras krekeleri* (WEGNER, 1905).
UPST L1, Upper Santonian *paraplanum* Subzone environs of Sougraigne.

narrowly rounded, inner flanks feebly convex, outer flanks convergent and venter narrowly arched. Ornament on phragmocone and early body-chamber is of delicate prorsiradiate growth lines, riblets and striae, straight and prorsiradiate on the flanks, flexed forward and markedly concave on the outer flank, crossing the venter in a narrow convexity. On the adapertural part of the fragment ornament differentiates into very widely spaced narrow ribs, feebly convex across the dorsum, swept back and concave over the dorsolateral margin, straight and feebly prorsiradiate across most of the flank, swept forwards and concave on outermost flank and ventrolateral shoulder, and crossing the venter in a marked convexity. There are subsidiary ventral riblets and striae between the ribs. PM A7-1 (Pl. 30, fig. 42) is a much larger, only feebly curved, crushed body-chamber with a maximum preserved whorl height of 25 mm; the rib index is four, the ribs very distant, strong and markedly concave on the flanks but much effaced across the venter. Suture with deeply incised bifid elements (Fig. 37).

Discussion : Compressed whorls and even ribbing readily separates *B. krekeleri* from *B. arculus* (MORTON, 1834) (p. 44, pl. 15, fig. 1, 2) see below; = *B. loescheri* RIEDEL, 1931), which has widely separated primary ribs with massive crescentic umbilicolateral bullae, and numerous fine-to-coarse short ventral ribs between successive primaries.

Occurrence : Upper Santonian *paraplanum* Subzone in the Corbières. The species is otherwise known only from the Münster Basin, where it is restricted to the Upper Santonian *Marsupites/granulata* Zone according to SCHÖNFELD (1985), the Upper Santonian Sandkalkbank at the Gosau Basin, Austria, and the Santonian of southern Sweden.

Boehmoceras arculus (MORTON, 1834)
Pl. 30, fig. 39, 40

1834. *Hamites arculus* MORTON (p. 44, pl. 15, fig. 1, 2).
1834. *Hamites arculus* var. A. MORTON (p. 45).
1931. *Boehmoceras löscheri* RIEDEL (p. 692, pl. 78, fig. 3-6).
1971. *Boehmoceras löscheri* RIEDEL; ULBRICH (pl. 5, fig. 4).
1979. *Boehmoceras loescheri* RIEDEL; SUMMESBERGER (p. 119, pl. 2, fig. 15, 16, 18, text-fig. 9-12).
1983b. *Boehmoceras* KENNEDY & WRIGHT (p. 866).
1985. *Boehmoceras loescheri* RIEDEL; SCHÖNFELD (pl. 2, fig. 6).
1987. *Boehmoceras loescheri* RIEDEL; KENNEDY (p. 777, pl. 82, fig. 4-16; text-fig. 2).
1991b. *Boehmoceras arculus* (MORTON, 1834); KENNEDY & COBBAN (p. 182, fig. 6:2; 8:9-15, 18-22; 9:1, 2, 11-52; fig. 10:20, 21, 24-26; 12:3).
1991. *Boehmoceras arculus* (MORTON, 1834); KENNEDY & CHRISTENSEN (p. 154, figures 3, 4 I).

Lectotype : By the subsequent designation of KENNEDY & CHRISTENSEN, 1991 (p. 155) is the specimen in the collections of Academy of Natural Sciences, Philadelphia, illustrated by KENNEDY & CHRISTENSEN as their text-figure 3, from the 'older Cretaceous strata of Greene County, Alabama', that is to say, the Tombigbee Sand Member of the Eutaw Formation.

Discussion : KENNEDY & COBBAN (1991b) revised this species, and illustrated an extensive suite of specimens from the Upper Santonian of Mississippi, Alabama and Texas. The single Corbières fragment (Pl. 30, fig. 39, 40) is a curved body-chamber 79 mm long with a maximum preserved whorl height of 20 mm. There are very widely separated flank ribs bearing crescentic dorsolateral bullae, with delicate ventral ribs and growth striae intercalated between.

Occurrence : Upper Santonian, Mississippi, Alabama and Texas, the Münster and Subhercynian Basins in Germany, southern Sweden, and the Gosau Basin, Austria. In France it is known from Assizes M^2 and N^2 of ARNAUD in northern Aquitaine. The Corbières occurrence is in the Middle Santonian *gallicus* Subzone.

Superfamily Scaphitaceae GILL, 1871
Family Scaphitidae GILL, 1871
Subfamily Scaphitinae GILL, 1871
Genus and subgenus *Scaphites* PARKINSON, 1811
(= *Anascaphites* HYATT, 1900 (p. 572); *Jahnnites* HYATT, 1900 (p. 572); *Holcoscaphites* NOWAK, 1911 (p. 564))

Type species : *Scaphites equalis* J. SOWERBY, 1813 (p. 53, pl. 18, fig. 1-3) by subsequent designation by MEEK, 1876 (p. 413).

Scaphites (*Scaphites*) *kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY, 1891
Pl. 30, fig. 23-25, 29-34

1891. *Scaphites kieslingswaldensis* LANGENHAN & GRUNDEY (p. 9, pl. 1, fig. 1).
1983. *Scaphites* cf. *texanus* ROEMER; COLLIGNON (p. 187, pl. 2, fig. 1).
1987. *Scaphites kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY, 1891; KAPLAN, KENNEDY & WRIGHT (p. 14, pl. 4, fig. 3-6; pl. 5, fig. 1-5 (with synonymy)).
1991. *Scaphites kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY; KENNEDY & CHRISTENSEN (p. 222, pl. 3, fig. 2; pl. 4, fig. 2, 6; pl. 5, fig. 1).
1994. *Scaphites kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY, 1891; KAPLAN & KENNEDY (p. 60, pl. 40, fig. 9-14; pl. 41, fig. 1-13).
1994. *Scaphites poitieri* GROSSOUVRE; WIEDMANN (p. 233, pl. 43, fig. 5).

Type : The holotype, by monotypy is the original of LANGENHAN & GRUNDEY, 1891 (pl. 1, fig. 1) refigured by FRITSCH, 1897 (text-fig. 20), STURM, 1901 (pl. 3, fig. 8, and (a plaster cast) KAPLAN, KENNEDY & WRIGHT, 1987 (pl. 5, fig. 5). It was from the Coniacian of Kieslingswalda, east of Klodzki (German Glatz).

Discussion : See KAPLAN, KENNEDY & WRIGHT (1987) for a full account of this species, and its synonyms. KENNEDY (1984a) figured French material from Touraine and Aquitaine, including the surviving type material of *S.* (*S.*) *meslei* de GROSSOUVRE, 1894, *S.* (*S.*) *lamberti* de GROSSOUVRE, 1894, and *S.* (*S.*) *poitieri* de GROSSOUVRE, 1894, here regarded as synonyms. The material from the Coniacian of the Corbières is all rather poorly preserved, but accords well with previous interpretation of the species. WIEDMANN (1994) regarded *S.* (*S.*) *poitieri* de GROSSOUVRE, 1894 (p. 242, pl. 22, fig. 3) as a distinct species, and described it from the Santonian of northern Spain. His specimen differs in no significant respects from that described by COLLIGNON (1983 : p. 187, pl. 2, fig. 1) as *Scaphites* cf. *texanus* ROEMER (Pl. 30, fig. 33, 34). ROEMER's species (1852 : p. 35, pl. 1, fig. 4) is based on a phragmocone only, from near New Braunfels, Texas, and its affinities are unclear.

Occurrence : *Scaphites* (*Scaphites*) *kieslingswaldensis kieslingswaldensis* is typically Coniacian, with records from the Czech Republic, Germany, Touraine, Aquitaine and Var in France, and northern Spain. In the Corbières the species ranges from the Coniacian *tridorsatum* and *margae* Zones, into the Santonian of northern Spain.

Scaphites leei Reeside, 1927, form II Cobban, 1969
Pl. 30, fig. 2-5, 6, 7-17, 20, 21, 26, 27

1894. *Scaphites* sp. de Grossouvre (p. 238, text-fig. 87).
1927. *Scaphites leei* Reeside (p. 26, pl. 20, fig. 17-22).
1939. *Scaphites* aff. *aquisgranensis* Schlüter; Basse (p. 50).
1939. *Scaphites senessi* Basse (p. 50, pl. 3, fig. 11, 12).
1969. *Scaphites leei* Reeside II; Cobban (p. 15, pl. 1, fig. 8-18).

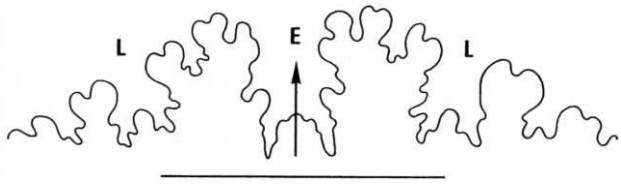

Figure 38
External suture of *Scaphites* (*Scaphites*) *leei* Reeside, 1927 form II of Cobban, 1969.
UM SEN 046, from the Upper Santonian pyritic *paraplanum* Subzone fauna of La Jouane. Bar scale is 10 mm.

Discussion : Basse (1939) based *Scaphites senessei* on approximately 20 pyritic nuclei, none exceeding 20 mm diameter, that rank as syntypes of the species. We have been unable to locate the two figured specimens, but illustrate two unfigured syntypes as Plate 30, figures 7-11. They are characterized by 16-18 prorsiradiate primary ribs per whorl that increases by branching and intercalation on the outer flank to give a total of 40 ribs per whorl at the ventrolateral shoulder. Basse also described a series of fragments as *S.* aff. *aquisgranesis* Schlüter (= *S. hippocrepis* Dekay, 1828), some of which are illustrated here as Plate 30, figures 12, 13, 16, 17 (others are *Yezoites*). Subsequent collecting has yielded individuals such as those shown as Plate 30, figures 14, 15 that show the two to be parts of the same species. Lack of tubercles on the spire, ventrolateral tubercles extending to the base of the body chamber plus the presence of up to four umbilical bullae on the body-chamber show these specimens to be form II of S. (S.) *leei* Reeside, 1927. See Cobban (1969) for an account of different successive forms of the *S. (S.) leei-S. (S.) hippocrepis* lineage.

Occurrence : Middle and Upper Santonian, upper part of *gallicus* Subzone and lower part of *paraplanum* Subzone. Marnes bleues de Sougraigne, La Jouane; Upper Santonian of Montana, Colorado and New Mexico in the U.S. Western Interior.

Subfamily Ostoscaphitinae Wright, 1953
Genus *Yezoites* Yabe, 1910
(= *Otoscaphites* Wright, 1953 (p. 475); *Hyposcaphites* Wiedmann, 1965 (p. 436))

Type species : *Scaphites perrini* Anderson, 1902 (p. 114) by subsequent designation by Diener, 1925 (p. 213).

Yezoites orbignyi nom. nov.
Pl. 30 fig. 22, 32, 35, 36

1842. *Scaphites compressus* d'Orbigny (p. 517, pl. 128, fig. 4, 5) (*non* Roemer, 1841).
1850. *Scaphites compressus* d'Orbigny (p. 214 (*pars*)).
1955d. *Scaphites compressus* d'Orbigny; Sornay (fig. 1-3).
? 1962. *S.* (*Scaphites*) *compressus* d'Orbigny; Wiedmann (p. 214 (*pars*) pl. 12, fig. 4).
1984a. *Scaphites compressus* d'Orbigny; Kennedy (p. 149, pl. 31, fig. 14).

Type : Holotype is MNHP d'Orbigny Collection no. 7139, the original of d'Orbigny, 1842 (pl. 128, fig. 4, 5) from the environs of Soulatgé, Aude (Pl. 30, fig. 22).

Description : The holotype is a macroconch. The spire appears to have been compressed. Ornament is of delicate, markedly flexuous ribs, convex across the inner flank and concave on the outer flank where they increase by branching and intercalation. The body chamber of the holotype is worn, but there are traces of delicate prorsiradiate flank ribs, and two umbilical bullae on the adapertural end of the shaft. The ribs increase by branching from delicate ventrolateral tubercles that extend over the greater part of the shaft but do not extend to the adult aperture. What seems to be the microconch of the species (PM RO-14) (Pl. 30 figs. 32, 36) is represented by a complete adult 19 mm long. The body-chamber is slender compared with that of the macroconch, lacks umbilical tubercles, but has large lateral lappets.

Discussion : *Scaphites compressus* of d'Orbigny, 1842, is a homonym of *Scaphites compressus* Roemer, 1841 (see Sherborn (1899) for an analysis of the dates of publication of d'Orbigny, 1840-1842). The delicate flexuous ribbing of the holotype of *compressus* matches that shown by *Yezoites arnaudi* (de Grossouvre, 1894) (p. 242, pl. 32, fig. 8); Kennedy, 1984a (pl. 31, fig. 20-24; text-fig. 42a, b)), but the latter lacks tubercles. A further curious scaphite in the UPST Collections (Pl. 30, fig. 28) has more, and bullate umbilical tubercles when compared to *Y. orbignyi*, but lacks ventrolateral nodes, and may be a *Yezoites* or *Scaphites* (*Scaphites*).

Occurrence : Upper Coniacian *margae* Zone to Lower Santonian *carezi* Subzone in the Corbières.

Yezoites spp.
Pl. 30, fig. 1, 18, 19, 43

Discussion : The pyritic faunas of the Marnes Bleues de Sougraigne yield minute *Yezoites* species that have adult phragmocones as little as 12.5 diameter, with delicate flexuous primary ribs on the flank and more numerous secondary and intercalated ribs across the venter. Body-chambers bear numerous delicate prorsiradiate primary ribs that may arise in groups as mere striae at the umbilical shoulder. They increase by branching on the outer flank and are strong across ventrolateral shoulders and venter. Thomel (1980 : p. 62, fig. 110) figured what may be a different species from Sougraigne that lacks such regular ribbing.

Occurrence : Middle and Upper Santonian, *gallicus* and *paraplanum* Subzones, Marnes bleues de Sougraigne, La Jouane, Corbières.

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7. — REFERENCES

ADKINS, W.S. (1928). — Handbook of Texas Cretaceous fossils. — *Univ. Texas Bull.*, 2838, 385 pp.

ALLEN, J.R.L. (1970). — Sediments of the modern Niger delta : a summary and review. — *In* : MORGAN, J.P. (ed.) : Deltaic sedimentation : modern and ancient. — *Soc. econ. Paleo. Mineral., spec. Publ*, 15, 138-51.

ALLEN, G.P. & MERCIER, F. (1987). — Les deltas : sédimentologie et exploitation pétrolière. — *Bull. Soc. géol. France*, 3, 8, 1247-1269.

AMÉDRO, F. & HANCOCK, J.M. (1985). — Les Ammonites de l'Autoroute "l'Aquitaine", France (Turonien et Santonien). — *Cretaceous Research*, 6, 15-32.

ANDERSON, F.M. (1902). — Cretaceous Deposits of the Pacific Coast. — *Proc. Calif. Acad. Sci*, 3 Geol. 2, 154 pp.

ANDERSON, F.M. (1958). — Upper Cretaceous of the Pacific Coast. — *Mem. geol. Soc. Amer.*, 71, 378 pp.

ARCHIAC, A. d'. (1859). — Les Corbières. — *Mém. Soc. géol. France*, 2, 6, 209-446.

ARKELL, W.J. (1950). — A classification of the Jurassic ammonites. — *J. Paleont.*, 24, 354-364.

ARNAUD, H. (1877a). — Mémoire sur le terrain crétacé du Sud-Ouest de la France. — *Mem. Soc. géol. France*, 2, 10, 110 pp.

ARNAUD, H. (1883b). — Parallélisme entre le Craie du Nord et celle du Sud-Ouest. — *Bull. Soc. géol. France*, 3, 11, 92.

ATABEKIAN, A.A. & AKOPIAN, V.T. (1970). — Late Cretaceous ammonites of the Armenian SSR (Pachydiscidae, Kossmaticeratidae and Scaphitidae). — *Izv. An Armen. SSR Nauk o Zemle*, 5, 31-42 [in Russian].

BAILY, W.H. (1855). — Description of some Cretaceous fossils from South Africa. — *Quart. J. geol. Soc. London*, 11, 454-465.

BASSE, E. (1931). — Monographie paléontologique du Crétacé de la Province de Maintirano. — *Mém. géol. Serv. Min. Madagascar*, 86 pp.

BASSE, E. (1939). — Sur quelques mollusques crétacés des Corbières méridionales. — *Bull. Soc. géol. France*, 5, 9, 35-38.

BASSE, E. (1947). — Les peuplements malgaches de *Barroisiceras* (Révision du genre *Barroisiceras* de GROSS). Paléontologie de Madagascar 26. — *Ann. Paléont*, 22, 97-190.

BAYLE, E. (1849). — Sur quelques fossiles de la Province de Constantine. — *In* : FOURNEL, H. : Richesse Minérale d'Algérie accompagnée d'éclaircissements historiques et géographiques sur cette partie de l'Afrique Septentrionale. — Imp. Nationale, Paris, 359-379.

BILOTTE, M. (1970). — Le Crétacé supérieur du synclinal de Rennes-les-Bains (Aude). — *Thèse, Univ. Paul-Sabatier, Toulouse*, 110 pp.

BILOTTE, M. (1982). — Approche biostratigraphique du Turonien Sous-Pyrénéen. — *Mém. Mus. natl. Hist. nat.* (Paris), e, 49, 97-102.

BILOTTE, M. (1985). — Le Crétacé supérieur des plates-formes est-pyrénées. — *Strata*, 2, 5, 438 pp.

BILOTTE, M. (1989). — Le Crétacé supérieur marin des Hautes-Corbières (Aude, France). Essais d'interprétation en termes de Stratigraphie séquentielle. — *Mém Centenaire Soc. Étud. Sc. Aude*, 83-90

BILOTTE, M. (1992). — Enregistrement sédimentaire et datation du passage de la marge stable à la marge convergente durant le Sénonien dans la zone sous-pyrénéenne orientale (Corbières, France). — *C.R. Acad. Sci.*, (Paris), 315, 2, 77-82.

BILOTTE, M. (1993). — Late Cretaceous Reefal Platform development in the Northeastern Pyrénées, France. — *In* : SIMO, T.J.A., SCOTT, R.W. & MASSE, J.P. (eds.) : Cretaceous Carbonate Platforms. — *Amer. Assoc. Petro. Geol., Mem.*, 56, 353-362.

BILOTTE, M. & COLLIGNON, M. (1983). — Biostratigraphie et Paléontologie des ammonites du Sénonien inférieur de Rennes-les-Bains-Sougraigne (Aude) [Zone sous-Pyrénéenne Orientale]. — *Docum. Lab. Géol. Fac. Sci. Lyon*, H.S. 6, 175-223.

BIRKELUND, T., HANCOCK, J.M., HART, M.B., RAWSON, P.F., REMANE, J., ROBASZYNSKI, F., SCHMID, F. & SURLYK, F. (1994). — Cretaceous stage boundaries-proposals. — *Bull. Geol. Soc. Denmark*, 33, 3-20.

BOLDOR, C., STILLA, A., IAVORSCHI, M. & DUMITRU, I. (1970). — Date noi in cunoasterea stratigrafiei si tectonicii sedimentarului mezozoic de la N de Olanesti (Carpatii Meridionali). — *Dari seama sedint.*, 5, *Tectonica si geologie regionala* 55 [for 1967-1968], 5-20.

BOULE, M., LEMOINE, P. & THÉVENIN, A. (1906-1907). — Paléontologie de Madagascar III : Céphalopodes crétacés des environs de Diego-Suarez. — *Ann. Paléont.*, 1, 173-192; 2, 1-56.

BOYLE, C.B. (1849). — A catalogue and bibliography of North American Mesozoic Invertebrates. — *Bull. US Geol. Surv.*, 102, 315 pp.

BRINKMANN, R. (1935). — Die Ammoniten der Gosau und des Flysch in den nördlichen Ostalpen. — *Mitt. geol. Staatsinst. Hamb.*, 15, 1-14.

BUCH, L. VON (1848a.) — Über Ceratiten, besonders von denen, die in Kreidebildung sich finden. — *Ber. Akad. Wiss. Berlin*, 214-223.

BUCH, L. VON (1848b). — Über Ceratiten. — *Phys. Abh. K. Akad. Wiss. Berlin*, 1-30.

BURCKHARDT, C. (1919-1921). — Faunas Jurasicas de Symon (Zacatecas) y faunas Crétacicas de Zumpango del Rio (Guerro). — *Bol. Inst. géol. México*, 33, 1-138 (1919), atlas (1921).

CHIPLONKAR, G.W. & GHARE, M.A. (1976). — Palaeontology of the Bagh Beds — Part VII : Ammonoidea. — *Bull. Earth Sci.*, 4-5, 1-10.

CLARK, D.L. (1963). — The heteromorph *Phlycticrioceras* in the Texas Cretaceous. — *J. Paleont.*, 37, 429-432.

COBBAN, W.A. (1969). — The Late Cretaceous ammonites *Scaphites leei* Reeside and *Scaphites hippocrepis* (DeKay) in the Western Interior of the United States. — *U.S. geol. Surv. prof. Pap.*, 619, 27 pp.

COBBAN, W.A. (1990). — The Upper Cretaceous ammonite *Eubostrychoceras* Matsumoto in the Western Interior of the United States. — *U.S. Geol. Surv. Bull.*, 1690, A1-A5.

COLLIGNON, M. (1932). — Paléontologie de Madagascar, XVII. Fossiles du Crétacé supérieur du Menabe. — *Ann. Paléont.*, 21, 35-87.

COLLIGNON, M. (1937). — Les ammonites pyriteuses de l'Aptien d'Antanatanamirafy. — *Ann. Paléont.*, 17, 107-132.

COLLIGNON, M. (1938). — Ammonites campaniennes et maestrichtiennes de l'ouest et du sud de Madagascar. — *Ann. géol. Serv. Mines Madagascar*, 9, 55-118.

COLLIGNON, M. (1948). — Ammonites néocrétacées du Menabe (Madagascar). I. Les Texanitidae. — *Ann. géol. Serv. Mines Madagascar*, 13, 49-107; 14, 7-101.

COLLIGNON, M. (1952). — Ammonites néocrétacées du Menabe (Madagascar) II — Les Pachydiscidae. — *Trav. Bur. geol. Haut Comm. Madagascar et Dép.*, 41, 114 pp.

COLLIGNON, M. (1955). — Ammonites néocrétacées du Menabe (Madagascar). II. Les Pachydiscidae. — *Ann. géol. Serv. Mines Madagascar*, 21, 98 pp.

COLLIGNON, M. (1956). — Ammonites néocrétacées du Menabe (Madagascar). IV. Les Phylloceratidae. V. Les Gaudryceratidae. VI. Les Tetragonitidae. — *Ann. géol. Serv. Mines Madagascar*, 23, 1-106.

COLLIGNON, M. (1961). — Ammonites néocrétacées du Menabe (Madagascar). VII. Les Desmoceratidae. — *Ann. géol. Serv. Mines Madagascar*, 31, 115 pp.

COLLIGNON, M. (1965a). — Atlas des fossiles caractéristiques de Madagascar (Ammonites), XIII, (Coniacien). — Service Géologique, Tananarive, 7, 88 pp.

COLLIGNON, M. (1965b). — Atlas des fossiles caractéristiques de Madagascar (Ammonites). XII, (Turonien). — Service Géologique, Tanarive, 4, 82 pp.

COLLIGNON, M. (1966). — Atlas des fossiles caractéristiques de Madagascar (Ammonites). XIV, Santonien. — Service géologique, Tananarive, 10, 134 pp.

COLLIGNON, M. (1969). — Atlas des fossiles caractéristiques de Madagascar (Ammonites). XV, (Campanien inférieur). — Service Géologique, Tananarive, 11, 216 pp.

COLLIGNON, M. (1983). — Les faunes d'Ammonites du Santonien. — *In* : BILOTTE, M. & COLLIGNON, M. : Biostratigraphie et paléontologie des Ammonites du Sénonien inférieur de Rennes-les Bains-Sougraigne (Aude) [zone sous-Pyrénéenne orientale]. — *Doc. Lab. Géol. Fac. Sci. Lyon*, H.S., 6, 184-223.

COLLIGNON, M., CREGUT, E., FABRE-TAXY, S., PHILIP, J. & TRONCHETTI, G. (1979). — Ammonites du Coniacien de Provence. — *Géol. Med.*, 6, 385-294.

COOPER, M.R. (1988). — Lower Campanian (Cretaceous) ammonites from Angola. — *S. Afr. J. Sci.*, 91, 207-211.

COQUAND, H. (1857). — Position des *Ostrea columba* et *biauriculata* dans le groupe de la craie inférieure. — *Bull. Soc. géol. France*, 2, 14, 745-766.

COQUAND, H. (1859). — Synopsis des animaux et des végétaux fossiles observés dans la formation crétacée du Sud-Ouest de la France. — *Bull. Soc. géol. France*, 2, 16, 945-1023.

DEKAY, J.E. (1828). — Report on several fossil multilocular shells from the state of Delaware : with observations on a second specimen of the new fossil genus EURYPTERUS. — *Ann. Lyceum Nat. Hist.*, 2, 273-279.

DESIO, A. (1920). — La Creta nil Bacino di Firenze. — *Palaeont. Ital.*, 26, 189-243.

DIENER, C. (1925). — Ammonoidea neocretacea. — *Fossilium Cat.* 29, 244 pp.

DIETRICH, W.O. (1938). — Zur Stratigraphie der Kreide im nordlich Zululand. — *Zbl. Miner. Geol. Paläont.* B, 1938, 228-240.

DOUVILLÉ, H. (1890). — Sur la classification des Cératites de la Craie. — *Bull. Soc. géol. France*, 3, 18, 275-292.

DOUVILLÉ, H. (1912). — Évolution et classification des Pulchelliides. — *Bull. Soc. géol. France*, 4, 11, 285-320.

DUJARDIN, F. (1837). — Mémoire sur les couches du sol en Touraine et description des coquilles de la craie et des Faluns. — *Mém. Soc. géol. France*, 2, 211-311.

FALLOT, E. (1885). — Étude géologique sur les étages moyens et supérieurs du terrain Crétacé dans le sud-est de la France. *Ann. Sci. Géol. Paris*, 18, 1-263.

FORBES, E. (1846). — Report on the Fossil Invertebrata from southern India, collected by Mr. Kaye and Mr. Cunliffe. — *Trans. geol. Soc. London*, 2, 7, 97-174.

FRITSCH, A. (1872). — Cephalopoden der bohmischen Kreidformationen. — Fr. Rivnác, Prague, 52 pp.

FRITSCH, A. (1897). — Studien im Gebiete der Böhmischen Kreideformation. — Palaeontologische Untersuchungen der einzelen Schichten. VI. Die Chlomeker Schichten. — *Arch. naturw. Landesdurch-Forsch. Böhmen*, 10 : 84 pp.

FRITSCH, A. & KAFKA, J. (1887). — Die Crustaceen der böhmischen Kreideformationen. — Selbstverlag, Prague, 53 pp.

GEINITZ, H.B. (1839-1842). — Charakteristik der Schichten und Petrefacten des sachsisch-bohmischen Kreidegebirges, [so wie der Vesteinerungen von Kieslingswalde.] — Dresden, 1-29 (1839); 31-62 (1840); 63-116 (1842).

GEINITZ, H.B. (1849-1850). — Das Quadersandsteingebirge oder Kreidegebirge in Deutschland. — Craz and Gerlach, Freiberg, 293 pp.

GERHARDT, K. (1897). — Beitrage zur kenntniss der Kreideformation in Columbien. — *N. Jb. Min. Geol. Paläont. Beilbd.*, 11, 118-208.

GERTH, H. (1961). — Neue Ammonitenfunde in den Gosauschichten der Gosau und ihre stratigraphische Bedeutung. — *N. Jb. Geol. Palaont. Abh.*, 112, 119-142.

GILL, T. (1871). — Arrangement of the Families of Mollusks. — *Smithson. misc. Collect.*, 227, 49 pp.

GRADSTEIN, F.M., AGTERBERG, F.P., OGG, J.G., HARDENBOL, J., VEEN, P. VAN, THIERRY, J. & HUANG, Z. (1994). — A Mesozoic time scale. — *J. Geophys. Res.*, 99, B12, 51-74.

GROSSOUVRE, A. de (1894). — Recherches sur la craie supérieure, 2, Paléontologie. Les ammonites de la craie supérieure. — *Mém. Serv. Carte géol. France*, 264 pp.

GROSSOUVRE, A. de (1901). — Recherches sur la craie supérieur, part 1, no. 2, Stratigraphie générale. — *Mém. Serv. Carte géol. France*, 1013 pp.

HAGGART, J. (1989). — New and revised ammonites from the Upper Cretaceous Nanaimo Group of British Columbia and Washington State. — *Bull. geol. Surv. Canada*, 396, 181-221.

HANCOCK, J.M. (1991). — Ammonite time scales for the Cretaceous System. — *Cretaceous Research.*, 12, 259-291.

HANCOCK, J.M. & KENNEDY, W.J. (1993). — The high Cretaceous ammonite fauna from Tercis, Landes, France. — *Bull. Inst. Sci. nat. Belg.*, 63, 149-209.

HAUER, F. VON (1858). — Über die Cephalopoden aus der Gosauschichten. — *Beitr. Paläont. Osterr.*, 1, 7-14.

HAUER, F. VON. 1866. — Neue Cephalopoden aus der Gosaugebilden der Alpen. — *Sitzber. Akad. Wiss. Wien.*, 53, 1-9.

HENDERSON, R.A. & MCNAMARA, K.A. (1985). — Maastrichtian non-heteromorph ammonites from the Mira Formation, Western Australia. — *Palaeontology*, 28, 35-88.

HOEPEN, E.C.N. (1920). — Description of some Cretaceous ammonites from Pondoland. — *Ann. Tvl Mus.*, 7, 142-147.

HOEPEN, E.C.N. VAN (1921). — Cretaceous Cephalopoda from Pondoland. — *Ann. Tvl. Mus.*, 7, 142-147.

HOEPEN, E.C.N. VAN (1955). — Turonian-Coniacian ammonites from Zululand. — *S. Afr. J. Sci.*, 51, 361-377.

HOEPEN, E.C.N. (1965). — The Peroniceratinae and allied forms of Zululand. — *Mem. geol. Surv. S. Africa*, 55, 70 pp.

HOEPEN, E.C.N. (1968). — New Ammonites from Zululand. — *Ann. geol. Surv. S. Afr.*, 4, 157-181.

HOURCQ, V. (1950). — Paléontologie de Madagascar XXVIII. Sur quelques ammonites du Sénonien. — *Ann. Paléont.*, 35, 89-117.

HOUSA, V. (1967). — *Lewesiceras* Spath (Pachydiscidae, Ammonoidea) from the Turonian of Bohemia. — *Sb. geol. Ved. Praha*, P9, 7-49.

HUPSCH, J.W.C.A.F. (1768). — Neue in der Naturgeschichte des Niederdeutschlands gemachte Entdeckungen einiger selten und Wenig bekannten versteinerten schalthiere. — Frankfurt and Leipzig, der Metternischisschen Buchhandlung, 159 pp.

HYATT, A. (1889). — Genesis of the Arietidae. — *Smithson. Contr. Knowl.*, 673, 239 pp.

HYATT, A. (1900). — Cephalopoda. — *In* : ZITTEL, K.A. VON : Textbook of Palaeontology. — C.R. Macmillan, London, 502-604.

HYATT, A. (1903). — Pseudoceratites of the Cretaceous. — *U. S. geol. Surv. Monogr.*, 44, 351 pp.

IMMEL, H. (1987). — Die Kreideammoniten der nördlichen Kalkalpen. — *Zitteliana*, 15, 3-163.

IMMEL, H., KLINGER, H.C. & WIEDMANN, J. (1982). — Die Cephalopoden des Unteren Santon der Gosau von Brandenberg/Tirol, Österrich. — *Zitteliana*, 8, 3-32.

JACOB, Ch. (1938). — Carte géologique détaillée de la France au 1/80 000; *Feuille de Quillan*, 254, 2e éd.

JARVIS, I. & GALE, A.S. (1984). — The Late Cretaceous transgression in the S.W. Anglo-Paris Basin : stratigraphy of the Craie de Villedieu Formation. — *Cretaceous Research*, 5, 195-224.

JIMBO, K. (1894). — Beiträge zur Kenntniss der Fauna der Kreideformation von Hokkaido. — *Paläont. Abh.*, N.S. 2, 147-194.

KAPLAN, U. & KENNEDY, W.J. (1994). — Ammoniten des Westfälischen Coniac. — *Geol. Paläont. Westf.*, 31, 154 pp.

KAPLAN, U. & SCHMID, F. (1988). — Die heteromorphen Ammoniten der Gattung *Eubostrychoceras* und *Hyphantoceras* aus dem Turon NW — Deutschlands. — *Geol. Paläont. Westf.*, 12, 47-87.

KAPLAN, U., KENNEDY, W.J. & WRIGHT, C.W. (1987). — Turonian and Coniacian Scaphitidaea from England and North-West Germany. — *Geol. Jb.*, A103, 5-39.

KARSTEN, H. (1858). — Über die geognostischen Verhältnisse des westlichen Columbien, der heutigen Republiken Neu-Granada und Equador. — *Amt. Ber. 32 Versamm. Deutch. Naturf. Ärzte Wien* (1856), 80-117.

KARSTEN, H. (1886). — Géologie de l'ancienne Colombie bolivarienne, Vénézuela, Nouvelle-Grenade et Ecuador. — Friedländer & Sohn, Berlin, 62 pp.

KENNEDY, W.J. (1984a). — Systematic palaeontology and stratigraphic distribution of the ammonite faunas of the French Coniacian. — *Spec. Pap. Palaeont.*, 31, 160 pp.

KENNEDY, W.J. (1984b). — Ammonite faunas and the "standard zones" of the Cenomanian to Maastrichtian stages in their type areas, with some proposals for the definition of the stage boundaries by ammonites. — *Bull. geol. Soc. Denmark*, 33, 147-161.

KENNEDY, W.J. (1985). — Ammonite faunas of the Coniacian, Santonian and Campanian stages in the Aquitaine Basin. — *Géol. Méditerr.*, 10, 103-113.

KENNEDY, W.J. (1986a). — Campanian and Maastrichtian ammonites from northern Aquitaine, France. — *Spec. Pap. Palaeont.*, 36, 145 pp.

KENNEDY, W.J. (1986b). — Ammonite biostratigraphy of the Albian to basal Santonian. — *Phys. Chem. Earth*, 16, 129-182.

KENNEDY, W.J. (1987). — Ammonites from the type Santonian and adjacent parts of northern Aquitaine, western France. — *Palaeontology*, 30, 765-782.

KENNEDY, W.J. & CHRISTENSEN, W.K. (1991). — Coniacian and Santonian ammonites from Bornholm, Denmark. — *Bull. geol. Soc. Denmark*, 38, 203-226.

KENNEDY, W.J. & COBBAN, W.A. (1991a). — Coniacian ammonite faunas from the United States Western Interior. — *Spec. Pap. Palaeont.*, 45, 96 pp.

KENNEDY, W.J. & COBBAN, W.A. (1991b). — Upper Cretaceous (Upper Santonian) *Boehmoceras* fauna from the Gulf Coast region of the United States. — *Geol. Mag.*, 128, 167-189.

KENNEDY, W.J. & HENDERSON, R.A. (1991). — A note on *Ammonites Sugata* Forbes, 1846. — *N. Jb. Geol. Paläont. Mh.*, 1991, 8, 470-476.

KENNEDY, W.J. & HENDERSON, R.A. (1992a). — Non-heteromorph ammonites from the Upper Maastrichtian of Pondicherry, South India. — *Palaeontology*, 35, 381-442.

KENNEDY, W.J. & HENDERSON, R.A. (1992b). — Heteromorph ammonites from the Upper Maastrichtian of Pondicherry, South India. — *Palaeontology*, 35, 693-731.

KENNEDY, W.J. & KAPLAN, U. (1995). — *Parapuzosia seppenradensis* (LANDOIS) und die Ammoniten fauna der Dülmener Schichten, Westfälen. — *Geol. Paläont. Westf.*, 31, 155 pp.

KENNEDY, W.J. & KLINGER, H.C. (1977). — Cretaceous faunas from Zululand and Natal, South Africa. The ammonite family Tetragonitidae Hyatt, 1900. — *Ann. S. Afr. Mus.*, 73, 149-197.

KENNEDY, W.J. & KLINGER, H.C. (1979). — Cretaceous faunas from Zululand and Natal, South Africa. The ammonite family Gaudryceratidae. — *Bull. Br. Mus. nat. Hist. (Geol.)*, 31, 2, 121-174.

KENNEDY, W.J. & SUMMESBERGER, H. (1979). — A revision of *Ammonites mitis* Hauer and *Ammonites glaneggensis* Redtenbacher from the Gosau Beds (Upper Cretaceous) of Austria. — *Beitr. Paläont. Öst.*, 6, 71-87.

KENNEDY, W.J. & WRIGHT, C.W. (1983a). — *Ammonites polyopsis* Dujardin, 1837 and the Cretaceous ammonite family Placenticeratidae Hyatt, 1900. — *Palaeontology*, 26, 855-873.

KENNEDY, W.J. & WRIGHT, C.W. (1983b). — Evolutionary patterns in Late Cretaceous ammonites. — *Spec. Pap. Palaeont.*, 33, 131-143.

KENNEDY, W.J., KLINGER, H.C. & SUMMESBERGER, H. (1981a). — Cretaceous faunas from Zululand and Natal, South Africa. Additional observations on the ammonite subfamily Texanitinae Collignon, 1948. — *Ann. S. Afr. Mus.* 86, 115-155.

KENNEDY, W.J., SUMMESBERGER, H. & KLINGER, H.C. (1981b). — On *Ammonites serratomarginatus* Redtenbacher, 1873, and *Ammonites quinquenodosus* Redtenbacher, 1873. — *Ann. S. Afr. Mus.*, 86, 117-137.

KENNEDY, W.J. WRIGHT, C.W. & KLINGER, H.C. (1983). — Cretaceous faunas from Zululand and Natal, South Africa. The ammonite subfamily Barroisiceratinae Basse, 1947. — *Ann. S. Afr. Mus.*, 90, 241-324.

KENNEDY, W.J. HANSOTTE, M., BILOTTE, M. & BURNETT, J. (1992). — Ammonites and nannofossils from the Campanian of Nalzen (Ariége, France) — *Géobios*, 25, 263-278.

KLINGER, H.C. (1976). — Cretaceous heteromorph ammonites from Zululand. — *Mem. geol. Surv. S. Afr.*, 69, 142 pp.

KLINGER, H.C. (1985). — Upper Cretaceous Cephalopods from offshore deposits off the Natal south coast, South Africa. — *Palaeont. afr.*, 26, 1-11.

KLINGER, H.C. & W.J. KENNEDY. (1980). — Cretaceous faunas from Zululand and Natal, South Africa. — The ammonite subfamily Texanitinae Collignon, 1948. — *Ann. S. Afr. Mus.*, 80, 1-357.

KLINGER, H.C. & KENNEDY, W.J. (1984). — Cretaceous faunas from Zululand and Natal, South Africa. The ammonite Subfamily Peroniceratinae Hyatt, 1900. — *Ann. S. Afr. Mus.*, 92, 113-294.

KLINGER, H.C. & KENNEDY, W.J. (1989). — Cretaceous faunas from Zululand and Natal, South Africa. The ammonite family Placenticeratidae Hyatt, 1900; with comments on the systematic position of the genus *Hypengonoceras* Spath, 1924. — *Ann. S. Afr. Mus.*, 98, 241-408.

KOBAYASHI, T. (1934). — The Cambro-Ordovician Formations and Faunas of South Chosen. — *J. Fac. Sci. Tokyo Imp. Univ.*, 3, 329-519.

KOSSMAT, F. (1895-1898). — Untersuchungen über die Sudindische Kreideformation. — *Beit. Paläont. Osterr.-Ungaren u. Orient*, 9, 1895, 97-203; 11, 1897a, 1-46; 11, 1898, 89-152.

KUCHLER, T. & ERNST, G. (1989). — Integrated biostratigraphy of the Turonian-Coniacian transition interval in northern Spain with comparison to NW Germany. — *In* : WIEDMANN, J. (ed.) : Cretaceous of the Western Tethys. — Schweizerbart'sche Verlagsbuchhandlung, xiv + 1005 p. : 161-190; Stuttgart.

KULLMAN, J. & WIEDMANN, J. (1970). — Significance of sutures in phylogeny of Ammonoidea. — *Paleont. Contrib. Univ. Kansas*, 44, 1-32.

LAMARCK, J.P.B.A. de M. de (1799). — Prodrome d'une nouvelle classification des coquilles. — *Mém. Soc. Hist. nat. Paris*., 63-90.

LAMARCK, J.P.B.A. de M. de (1801). — Système des Animaux sans vertèbres. — Deterville, Paris, 432 pp.

LANGENHAN, A. & GRUNDEY, M. (1981). — Das Kieslingswalder Gestein und seine Versteinerungen. — *Jahresb. Glatzer Gebirgs-Vereins*, 10, 12 pp.

LASSWITZ, R. (1904). — Die Kreide-Ammoniten von Texas (Collectio F. Roemer). — *Geol. Paläeont. Abh., n.s.*, 6, 10, 221-259.

LEWY, Z. (1983). — A well-preserved Upper Santonian heteromorph ammonite from Israel. — *Geol. Surv. Israel, Current Res.*, 1982, 24-27.

MACOVEI, C. (1906). — Note sur un *Pachydiscus* du Crétacé supérieur de Babadag (Dobrogea). — *Ann. Sci. Univ. Jassy*, 4, 1, 78-81.

MARIANI, E. (1898). — Ammoniti del Senoniano Lombardo. — *Mem. Inst. lombardo*, Cl. *Sci. Matem. nat.*, 3, 18, 51-58.

MARTINEZ, R. (1982). — Ammonoideos cretacicos del Prepirineo de la Provincia de Lleida. — *Publ. geol. Univ. Auton. Barcelona*, 17, 197 pp.

MATSUMOTO, T. (1938). — A biostratigraphic study on the Cretaceous deposits of the Naibuchi Valley, South Karahuto. — *Proc. Imperial Acad. Japan*, 14, 190-194.

MATSUMOTO, T. (1942). — A note on the Japanese Cretaceous ammonites belonging to the subfamily Desmoceratinae. — *Proc. Imp. Acad. Japan*, 18, 24-29.

MATSUMOTO, T. (1954). — Family Puzosiidae from Hokkaido and Saghalien. — *Mem. Fac. Sci. Kyushu Univ.*, D, 5, 69-118.

MATSUMOTO, T. (1955a). — Evolution of Peroniceratidae. — *Tran. Proc. Palaeont. Soc. Japan*, 18, 37-44.

MATSUMOTO, T. (1955b). The bituberculate pachydiscids from Hokkaido and Saghalien. — *Mem. Fac. Sci. Kyushu Univ., D.*, 5, 153-184.

MATSUMOTO, T. (1959). — The Upper Cretaceous Ammonites of California. Part 1. — *Mem. Fac. Sci. Kyushu Univ.*, D, 8, 91-171.

MATSUMOTO, T. (1965). — A monograph of the COLLIGNONICERATIDAE from Hokkaido. Part 2. — *Mem. Fac. Sci. Kyushu Univ.*, D., 16, 209-243.

MATSUMOTO, T. (1966a). — A Cretaceous Ammonite from the Island of Curaçao, Netherlands Antilles. — *Mem. Fac. Sci. Kyushu Univ.*, D., 17, 277-294.

MATSUMOTO, T. (1966b). — A note on *Ammonites flaccidicosta* Roemer from the Cretaceous of Texas. — *Trans. Proc. Palaeont. Soc. Japan*, 63, 294-302.

MATSUMOTO, T. (1967). — Evolution of the Nostoceratidae (Cretaceous heteromorph ammonoids). — *Mem. Fac. Sci. Kyushu Univ.*, D, 18, 331-347.

MATSUMOTO, T. (1970a). — Uncommon Keeled Ammonites from the Upper Cretaceous of Hokkaido and Saghalien. — *Mem. Fac. Sci. Kyushu Univ.*, D., 20, 305-317.

MATSUMOTO, T. (1970b). — A Monograph of the COLLIGNONICERATIDAE from Hokkaido. Part IV. — *Mem. Fac. Sci. Kyushu Univ.*, D., 20, 225-304.

MATSUMOTO, T. (1971). — A monograph of the Collignoniceratidae from Hokkaido. Part V. — *Mem. Fac. Sci. Kyushu Univ.*, D, 21, 129-162.

MATSUMOTO, T. (1972). — *In* : MATSUMOTO, T., MURAMOTO, T. & TAKAHASHI, T. : A new gaudryceratine ammonite from Hokkaido. — *Mem. Fac. Sci. Kyushu Univ.*, D, 21, 207-215.

MATSUMOTO, T. (1979). — Notes on *Lewesiceras* and *Nowakites* (Pachydiscid ammonites) from the Cretaceous of Hokkaido. — *Trans. Proc. Palaeont. Soc. Japan*. N.S. 113, 30-44.

MATSUMOTO, T. (1985). — Restudy of *Crioceras spinigerum* Jimbo, a Cretaceous ammonite species. — *Proc. Jap. Acad.*, B61, 51-59.

MATSUMOTO, T. (1988). — A monograph of the Puzosiidae (Ammonoidea) from the Cretaceous of Hokkaido. — *Palaeont. Soc. Japan Spec. Pap.*, 30, 179 pp.

MATSUMOTO, T. & OBATA, I. (1955). — Some Upper Cretaceous desmoceratids from Hokkaido and Saghalien. — *Mem. Fac. Sci., Kyushu Univ.*, D, 5, 119-151.

MATSUMOTO, T. & TOSHIMITSU, S. (1984). — On the systematic position of the two ammonite genera *Hourquia* COLLIGNON, 1965 and *Pseudobarroisiceras* SHIMIZU, 1932. — *Mem. Fac. Sci. Kyushu Univ.*, D, 25, 229-245.

MATSUMOTO, T., MIYAUCHI, T. & KANIE, Y. (1985). — Some gaudryceratid ammonites from the Campanian and Maastrichtian of Hokkaido. Part II. — *Sci. Rep. Yokosuka City Mus.*, 33, 19-36.

MATSUMOTO, T. MURAMOTO, K., TAKAHASHI, T., YAMASHITA, M. & KAWASHITA, Y. (1986). — On *Neocrioceras spinigerum* (JIMBO), a species of Cretaceous heteromorph ammonoids. — *Trans. Proc. Palaeont. Soc. Japan.*, 143, 463-474.

MEEK, F.B. (1876). — A report on the invertebrate Cretaceous and Tertiary fossils of the upper Missouri country. — *U. S. Geol. Surv. Territ.*, 9, 629 pp.

MOBERG, J.C. (1885). — Cephalopoderna i Sveriges Kritsystem. II. — *Sver. geol. Unders. Afh.*, C, 73, 1-63.

MORTON, S.G. (1834). — Synopsis of the organic remains of the Cretaceous groups of the United States. Illustrated by nineteen plates, to which is added an appendix containing a tabular view of the Tertiary fossils discovered in America. — KEY & BIDDLE, Philadelphia, 88 pp.

MULLER, G. & WOLLEMANN, A. (1906). — Die Mollusken fauna des Untersenon von Braunschweig und Ilsede. II. Die Cephalopoden. — *Abh. preuss. geol. Landesanst.*, 47, 1-30.

NOWAK, J. (1911). — Untersuchungen über die cephalopoden der oberen Kreide in Polen. II. Teil. Die skaphiten. — *Bull. Acad. Sci. Cracovie. Cl. Sci. Math. Nat. Sér. B Sci. Nat.*, 547-589.

NOWAK, J. (1913). Untersuchungen über die cephalopoden der oberen Kreide in Polen. III Teil. — *Bull. Acad. Sci. Cracovie. Cl. Sci. Math. Nat. Sér. B Sci. Nat.*, 335-415.

OBRADOVICH, J. (1993). — A Cretaceous Time Scale. — *In* : CALDWELL, W.G.E. (ed.) : Evolution of the Western Interior Basin. — *Geol. Assoc. Can. Spec. Pap.*, 39, 379-396.

ORBIGNY, A. d'. (1840-1842). — Paléontologie française : Terrains crétacés, 1, Céphalopodes. — Masson, Paris; 1-120 (1840); 121-430 (1841); 431-662 (1842).

ORBIGNY, A. d'. (1850). — Prodrome de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés faisant suite au cours élémentaire de Paléontologie et de Géologie stratigraphiques. — Masson, Paris, 427 pp.

PARKINSON, J. (1811). — Organic remains of a former world. — J. Robson, London, 479 pp.

PARNES, A. (1964). — Coniacian ammonites from the Negev (southern Israel). — *Bull. geol. Surv. Israel*, 39, 1-42.

PAULCKE, W. (1907). — Die Cephalopoden der oberen Kreide Südpatagoniens. — *Ber. Naturf. Gesell. Freiburg i Breisgau*, 15, 167-248.

PERON, A. (1889-1895). — Description des mollusques fossiles des terrains crétacés de la région sud des Hauts-Plateaux de la Tunisie recueillis en 1885 et 1886 par M. Philippe Thomas. — *Explor. Sci. Tunisie*, 1-103 (1889); 105-327 (1895); 328-405 (1895), Masson, Paris.

PERON, M. (1896-1897). — Les ammonites du Crétacé supérieur de l'Algérie. — *Mém. Soc. géol. France*, 17, 6, 1-24 (1896); 7, 25-88 (1897).

PERVINQUIÈRE, L. (1907). — Études de paléontologie tunisienne. 1. Céphalopodes des terrains secondaires. — Carte géol. Tunisie, de Rudeval, Paris, 438 pp.

PICTET, F.J. (1847). — *In* : PICTET, F.J. & ROUX, W. (1847-1854). Description des mollusques fossiles qui se trouvent dans les Grés Verts des environs de Genève. — *Mém. Soc. Phys. Hist. nat. Genéve*, 11 (1847); 12 (1849); 13 (1852); 14 (1854).

PLATEL, J.-P. (1989). — Le Crétacé supérieur de la plateforme septentrionale du Bassin d'Aquitaine.— *Doc. Bull. Rech. géol. min.*, 164, 572 pp.

REDTENBACHER, A. (1873). — Die Cephalopodenfauna der Gosauschichten in den nordöstlichen Alpen. — *Abh. K.-K. geol. Reichsanst.*, 5, 91-140.

REESIDE, J.B. Jr. (1927). — The cephalopods of the Eagle Sandstone and related formations in the Western Interior of the United States. — *U. S. geol. Surv. Prof. Pap.*, 151, 87 pp.

REESIDE, J.B. Jr. (1932). — The Upper Cretaceous ammonite genus *Barroisiceras* in the United States. — *U. S. geol. Surv. Prof. Pap.*, 170-B, 9-29.

RENZ, H.H. (1936). — Neue Cephalopoden aus der oberen Kreide vom Rio Grande del Norte (Mexico und Texas) mit einer Einführung von Walther STAUB. — *Abh. schweiz. paläont. ges.*, 57, 1-16.

RENZ, O. (1982). — The Cretaceous ammonites of Venezuela. — Basel, Maraven, 132 pp.

REYMENT, R.A. (1958a). — Neubeschreibung der Redtenbacher'schen ammoniten-originale aus den Gosauschichten. — *Stockholm Contr. Geol.*, 2, 31-49.

REYMENT, R.A. (1958b). — Übersichtliche Ergänzung zu F. Solger's, Die Fossilien der Mungokreide in Kamerun und ihre geologische Bedeutung" (1904). — *Stockholm Contr. Geol.*, 2, 51-72.

REYMENT, R.A. (1958c). — Über einige Ammoniten aus dem Coniac Kolumbiens und Venezuelas, Südamerika. — *Stockholm Contr. Geol.* 2, 1, 1-25.

RIEDEL, L. (1931). — Zur Stratigraphie und Faciesbildung im Oberemscher und Untersenon im Südrande des Beckens von Münster. — *J.r Preuss. geol. Landesanst Bergakad.*, 51, 605-713.

ROEMER, A. (1840-1841). — Die Versteinerungen des norddeutschen Kreidegebirges. — Hahn'schen Hofbuchhandlung, Hannover, 1-48 (1840); 49-145 (1841).

ROEMER, F.A. (1852). — Die Kreidebildungen von Texas und ihre organischen Einschlüsse. — Adolph Marcus, Bonn, 100 pp.

ROLLAND DU ROQUAND, O. (1841). — Description des coquilles fossiles de la famille des Rudistes qui se trouvent dans le terrain crétacé des Corbières (Aude). — Imp. Pomiés-Gardel, Carcassonne, 69 pp.

ROLLIER, L. (1922). — Phylogénie des Ammonoïdes. — *Eclogae geol. Helv.*, 17, 358-360.

ROMAN, F. (1938). — Les ammonites jurassiques et crétacées. Essai de genera. — Masson, Paris, 554 pp.

ROMAN, F. & MAZERAN, P. (1913). — Monographie paléontologique de la faune du Turonien du bassin d'Uchaux et de ses dépendances. — *Archs. Mus. Hist. nat. Lyon*, 12, 137 pp.

ROUSSEL, J. (1893). — Etude stratigraphique des Pyrénées. — *Bull. Carte géol. France*, 5, 35, 306 pp.

SALFELD, H. [J.C.A]. (1924). — *Die Bedeutung der Konservativstämme fur die Stammesentwicklung der Ammonoideen.* — Leipzig, 16 pp.

SANTAMARIA-ZABALA, R. (1992). — Los Ammonoideos del Cenomaniense superior al Santoniense de la plataforma nord-castellana y la cuenca navarro-cantabra. Parte 1. Bioestratigrafia sistematica : Phylloceratina, Ammonitina (Desmoceratáceae y Hoplitaceae) y Ancyloceratina. — *Trab. Mus. Geol. Barcelona*, 2, 171-268.

SCHLÜTER, C. (1867). — Beitrag zur Kenntniss der jüngsten Ammoneen Norddeutschlands. — A. Henry, Bonn, 36 pp.

SCHLÜTER, C. (1871-1876). — Cephalopoden der oberen deutschen Kreide. — *Palaeontographica*, 21, 1-24 (1871); 21, 25-120 (1872a); 24, 121-264 (1876).

SCHLÜTER, C. (1872b). — *Verh. naturh. Ver. preuss. Rheine*, 29, *Correspondenzblatt* 1, 91-92.

SCHLÜTER, C. (1875). — Über die Gattung *Turrilites* und die Verbreitung ihrer Arten in der mittleren Kreide Deutschlands. — *Sitzber. Niederrhein. Ges. Natur-und Heilkunde*, 32, 27-31.

SCHÖNFELD, J. (1985). — Lithologie, Biostratigraphie und Fossilführung des Ober-Santon Mergels von Westerwiehe (Ostwestfalen). — *Geol. Palaeont. Westf.*, 5, 7-50.

SÉNESSE, P. (1937). — Contribution à l'étude du Crétacé supérieur des Corbières méridionales. — Imp. Douladoure, Toulouse, 182 pp.

SÉNESSE, P. (1956). — Les trois faciès du Coniacien des Corbières méridionales. — *Bull. Soc. Linnéenne Lyon*, 6, 161-168.

SÉRONIE-VIVIEN, M. (1972). — Contribution à l'étude du Sénonien en Aquitaine septentrionale. Ses stratotypes : Coniacien, Santonien, Campanien. — Ed. C.N.R.S. Paris, 2, 187 pp.

SÉRONIE-VIVIEN, M. (1980). — Coniacien-Santonien. Les étages français et leurs stratotypes. — *Mém Bur. Rech. géol. min.*, 109, 150-160.

SEUNES, J. (1892). — Contribution à l'étude des Céphalopodes du Crétacé supérieur de France. I. Ammonites du Calcaire à Baculites du Cotentin (suite). II. Ammonites du Campanien de la région sous-pyrénéenne. Département de Landes. — *Mém. Soc. geol. France*. 2, 8-22.

SHARPE, D. (1853-57). — Description of the fossil remains of Mollusca found in the Chalk of England. I, Cephalopoda. — *Palaeont. Soc. Monogr.*, 1-26 (1853); 27-36 (1855); 37-68 (1857).

SHERBORN, C.D. (1889). — On the dates of the "Paléontologie française" of d'Orbigny. — *Geol. Mag.*, 4, 6, 223-225.

SHIMIZU, S. (1932). — On a new type of Senonian ammonite, *Pseudobarroisiceras nagaoi* Shimizu gen. et sp. nov. from Teshio Province, Hokkaido. — *Jap. J. Geol. Geog.*, 10, 1-4.

SHIMIZU, S. (1934). — Ammonites. — *In* : SHIMIZU, S. & OBATA, T. : Cephalopoda. — Iwanami's lecture series of Geology and Palaeontology, Tokyo, 137 pp. [In Japanese].

SHIMIZU, S. (1935). — The Upper Cretaceous Ammonites. So-called *Hamites* in Japan. — *Proc. Imp. Acad.* 11, 271-273.

SORNAY, J. (1955a). — *Ammonites (Nowakites) pailletteanus*. — *Paleont. Univers.*, N.S. 12, 3 pp.

SORNAY, J. (1955b). — *Turrilites (Bostrychoceras) acuticostatus*. — *Paleont. Univers.*, N.S. 6, 2 pp.

SORNAY, J. (1955c). — *Turrilites (Bostrychoceras) plicatus*. — *Paleont. Univers.*, N.S. 7, 2 pp.

SORNAY, J. (1955d). — *Scaphites compressus*. — *Palaeont. Univers.*, N.S. 4, 2 pp.

SOWERBY, J. (1812-1822). — The mineral conchology of Great Britain. — The author, London.

SOWERBY, J. de C. (1850). — Description of the shells of the Chalk Formation. — *In* : DIXON, F. : The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex. — W.J. Smith, Brighton, 346-359.

SPATH, L.F. (1921a). — On Upper Cretaceous Ammonoidea from Pondoland. — *Ann. Durban Mus.*, 3, 39-56.

SPATH, L.F. (1921b). — On Cretaceous Cephalopoda from Zululand. — *Annls S. Afr. Mus.*, 12, 217-321.

SPATH, L.F. (1922). — On the Senonian ammonite fauna of Pondoland. — *Trans. R. Soc. S. Afr.*, 10, 113-147.

SPATH, L.F. (1925a) — On Senonian Ammonoidea from Jamaica. — *Geol. Mag.*, 62, 28-32.

SPATH, L.F. (1925b). — On Upper Albian Ammonoidea from Portuguese East Africa, with an appendix on Upper Cretaceous ammonites from Maputoland. — *Annl. Tvl. Mus.*, 11, 179-200.

SPATH, L.F. (1926). — On new ammonites from the English Chalk. — *Geol. Mag.*, 63, 77-83.

SPATH, L.F. (1927). — Revision of the Jurassic Cephalopod fauna of Kachh (Cutch). — *Mem. geol. Surv. India Palaeont. Indica*, 11, 1-71.

SPATH, L.F. (1929). — Corrections of cephalopod nomenclature. — *Naturalist*, 871, 269-271.

SPATH, L.F. (1932). — A monograph of the Ammonoidea of the Gault. — *Palaeontogr. Soc. Monogr.*, 9, 379-410.

SPATH, L.F. (1939). — A monograph of the Ammonoidea of the Gault. — *Palaeontogr. Soc. Monogr.*, 13, 541-608.

SPATH, L.F. (1953). — The Upper Cretaceous Cephalopod fauna of Grahamland. — *Sci. Rep. Br. Antarct. Surv.*, 3, 1-60.

STANTON, T.W. (1895). — Contributions to the Cretaceous Palaeontology of the Pacific Coast. The fauna of the Knoxville Beds. — *Bull. U.S. Geol. Surv.*, 133, 132 pp.

STOLICZKA, F. (1863-1866). — The fossil cephalopoda of the Cretaceous rocks of southern India. Ammonitidae with revision of the Nautilidae, etc. — *Mem. geol. Surv. India, 1, Palaeontol. India,* 3, 41-56 (1863), 57-106 (1864), 107-154 (1865), 155-216 (1866).

STROMBECK, A. von (1859). — Ueber die Kreide am Zeltberg bei Lüneburg. — *Z. Dtsch. geol. Ges.*, 15, 1, 97-187.

STURM, F. (1901). — Der Sandstein von Kieslingswalda in der Grafschatz Glatz und Seine Fauna. — *Jb. preuss. geol. Landesant. berg Akad.*, 21, 39-98.

SUESS, E. (1866). — Über Ammoniten. — *Sitzber. Akad. Wiss. Wien*, 52, 71-89.

SUMMESBERGER, H. (1979). — Eine obersanton Ammonitenfauna aus dem Becken von Gosau (Oberösterreich). — *Ann. Naturhist. Mus. Wien*, 82, 109-176.

SUMMESBERGER, H. (1980). — Neue Ammoniten aus der Sandkalkbank der Hochmoosschichten (Obersanton; Gosau; Österreich). — *Ann. Naturhist. Mus. Wien*, 83, 275-283.

SUMMESBERGER, H. (1985). — Ammonite Zonation of the Gosau Group (Upper Cretaceous, Austria). — *Ann. Naturhist. Mus., Wien*, 87A, 145-66.

SZÁSZ, L. (1981). — Contributions à l'étude des Ammonites coniaciennes de la Roumanie. — *Mem. Inst. geol. geofis.*, 30, 93-114.

SZÁSZ, L. & ION, J. (1988). — Crétacé supérieur du Bassin de Babadag (Roumanie). Biostratigraphie intégrée (ammonites, inocerames, foraminifères planktoniques). — *Mem. Inst. geol. géophis.*, 33, 91-149.

SZÁSZ, L. & LACATUSU, A. (1974). — Contributii la studiul amonitilor din Neocretacicul bazinului Babadag (Dobrogea de Nord). — *Dari Seama*, 205-215.

THIOLLIÈRE, V. (1849). — Note sur une nouvelle espèce d'ammonite provenant des grès verts supérieurs du Département de la Drôme. — *Ann. Sci. Phys. nat. Lyon*, 1, 11, 744-748.

THOMEL, G. (1980). — Ammonites. — Edit. Serre, Nice, 227 pp.

THOMEL, G. (1988). — Les ammonites néocrétacées (Coniacien – Santonien – Campanien) des Chaînes Subalpines Méridionales (Alpes-Maritimes et Alpes-de-Haute-Provence). — *Mém. Soc. géol. France*, N.S. 153, 79 pp.

TOMLIN, J.R.B. (1930). — Some preoccupied generic names. II. — *Proc. Malac. Soc.*, 19, 22-24.

TOUCAS, A. (1879). — Du terrain crétacé des Corbières et comparaison avec celui des autres bassins de la France et de l'Allemagne. — *Bull. Soc. géol. France*, 3, 8, 39-87.

TZANKOV, V. (1982). — Les Fossiles de Bulgarie du Crétacé supérieur. — Bulgarian Acad. Sc., 136 pp. [In Russian].

ULBRICH, H. (1971.) — Mitteilungen zur Biostratigraphie des Santon und Campan des mittleren Teils der Subherzynen Kreidemulde. — *Freib. Forshr.*, 267, 47-60.

USHER, J.L. (1952). — Ammonite faunas of the Upper Cretaceous of Vancouver Island, British Columbia. — *Bull. geol. Surv. Canada*, 21, 1-182.

VAN WAGONER, J.C., POSAMENTIER, H.W., MITCHUM, R.M., VAIL, P.R., SARG, J.F., LOUTIT, T.S. & HARDENBOL, J. (1988). — An overview of the fundamentals of sequence stratigraphy and key definitions. — *In* : WILGUS, C., HASTINGS, B., ROSS, C. POSAMENTIER, H. VAN WAGONER, J. & KENDALL, G.C. St. C. (eds.) : Sea-level changes; an integrated approach. — *Soc. econ. Paleo. Mineral. spec. Publ.*, 42, 39-45.

VAŠÍČEK, Z. (1992). — Coniacian ammonites from Stity in Moravia (Czechoslovakia). — *Sbornik geologickych ved. Paleont.*, 32, 163-195.

WEDEKIND, R. (1916).— Über Lobus, Suturallobus und Inzision. — *Z. Min. geol. Paläont.* B, 185-195.

WEGNER, T. (1905). Die Granulatenkreide des westlichen Münsterlandes. — *Z.Dtsch. geol. Ges.*, 57, 112-232.

WEIJDEN, W.J.M. (1943). — Die Macrofauna der Hervischen Kreide. — *Meded. geol. Sticht.*, C, 4, 139 pp.

WIEDMANN, J. (1960). — Le Crétacé supérieur de l'Espagne et du Portugal et ses céphalopodes. — C. R. Congrès Soc. Sav. Dijon, 1959, Colloque sur le Crétacé supérieur français, 709-764.

WIEDMANN, J. (1962). — Ammoniten aus der Vascogotischen Kreide (Nordspanien). 1, Phylloceratina, Lytoceratina. — *Palaeontographica*, 118A, 119-237.

WIEDMANN, J. (1964). — Le Crétacé supérieur de l'Espagne et du Portugal et ses céphalopodes. — *Estud. Geol. Inst. Lucas Mallada*, 20, 107-148.

WIEDMANN, J. 1965. — Origin, limits and systematic position of Scaphites. — *Palaeontology*, 8, 397-453.

WIEDMANN, J. (1966). — Stammesgeschichte und system der posttriadischen ammonoideen; ein Überblick. — *N. Jb. Geol. Paläont. Abh.*, 125, 49-79; 127, 13-81.

WIEDMANN, J. (1973). — The Albian and Cenomanian Tetragonitidae (Cretaceous Ammonoidea), with special reference to the Circum-Indic species. — *Eclogae. geol. Helv.*, 66, 585-616.

WIEDMANN, J. (1978). — Eine paläogeographisch interessante Ammonitenfaunula aus der alpinen Gosau. — *Eclogae. geol. Helv*, 71, 663-675.

WIEDMANN, J. (1979). — Ammonites. — *In* : HERM, D., KAUFFMAN, E.G. & WIEDMANN, J. : The age and depositional environment of the "Gosau" Group (Coniacian-Santonian), Brandenberg/Tirol, Austria. — *Mitt. Bayer. Staatssamml. für Paläont. hist. Geol.*, 19, 27-92.

WIEDMANN, J. (1994). — Systematic description of the age-defining ammonites. — *In* : GISCHLER, E., GRÄFE, K.-W. & WIEDMANN, J. : The Upper Cretaceous *Lacazina* Limestone in the Basco-Cantabrian and Iberian Basins of northern Spain : cold water grain associations in warm water environments. — *Facies*, 30, 232-242.

WOODS, H. (1896). — The Mollusca of the Chalk Rock. Part 1. — *Quart. J. geol. Soc. London*, 52, 68-98.

WRIGHT, C.W. (1952). — A classification of the Cretaceous Ammonites. — *J. Paleont.*, 26, 213-222.

WRIGHT, C.W. (1953). — Notes on Cretaceous ammonites. I, Scaphitidae. — *Ann. Mag. Nat. Hist.*, 12, 6, 473-476.

WRIGHT, C.W. (1957). — Cretaceous Ammonoidea. — *In* : MOORE, R.C. (ed.) : Treatise on Invertebrate Paleontology. Part L, Mollusca 4, Cephalopoda Ammonoidea. — Geol. Soc. Amer., Univ. Lawrence, New-York, 490 pp.

WRIGHT, C.W. (1979). — The ammonites of the English Chalk Rock (Upper Turonian). — *Bull. Br. Mus. Nat. hist. (Geol.)*, 31, 281-332.

WRIGHT, C.W. & MATSUMOTO, T. (1954). — Some doubtful Cretaceous ammonite genera from Japan and Saghalien. — *Mem. Fac. Sci. Kyushu Univ.*, D, 4, 107-134.

WRIGHT, C.W. & WRIGHT, E.V. (1951). — A survey of the fossil Cephalopoda of the Chalk of Great Britain. — Palaeontog. Soc. Monogr., 1-40.

YABE, H. (1910). — Die Scaphiten aus der Oberkreide von Hokkaido. — *Beitr. Paläont. Geol. Österr.-Ungaren Orient*, 23, 159-174.

YABE, H. (1927). — Cretaceous stratigraphy of the Japanese Islands. — *Sci. Rep. Tohoku Imp. Univ.*, 2, 11, 27-100.

YABE, H. & SHIMIZU, S. (1926). — A study of the genus "*Parapachydiscus*" HYATT. — *Proc. Imp. Acad. Japan*, 2, 171-173.

YOUNG, K. (1963). — Upper Cretaceous ammonites from the Gulf Coast of the United States. — *Univ. Texas Bull.*, 6304, 373 pp.

ZABORSKI, P.M.P. (1982). — Campanian and Maastrichtian sphenodiscid ammonites from southern Nigeria. — *Bull. Br. Mus. Nat. hist. (Geol.)*, 36, 303-332.

ZITTEL, K.A. VON (1884). — Handbuch der Palaeontology. Cephalopoda. — Oldenbourg, Munich, 329-522.

ZITTEL, K.A. VON (1895). — Grundzüge der Palaeontologie (Palaeozoologie). — Oldenbourg, Munich, 972 pp.

PLATE 1

Fig. 1, 2, 15-17. — *Pseudophyllites pyrenaicus* (de GROSSOUVRE,1894).
1, 2, SP unregistered 'Santonien inférieur, ravin de Montferrand, Montagne des Cornes', *ex* TOUCAS Collection. 15-17, lectotype, SP unregistered, *ex* TOUCAS Collection, 'Marnes bleues situées au-dessous du banc à *Lima marticensis* sur le chemin de Sougraigne aux Croutets', figured by de GROSSOUVRE, 1894 (pl. 25, fig. 2).

3-5, 9, 10, 18, 19. — *Phylloceras (Hypophylloceras) rousseli* (de GROSSOUVRE, 1894).
3-5, UM SEN-033, the original of BASSE, 1939 (pl. 3, fig. 2) from the Upper Santonian *paraplanum* Subzone, La Jouane. 9, 10, PM D5-24, from the Middle Santonian *gallicus* Subzone, Ravin de la Coume. 18, 19, lectotype, MNHP R409, the original of de GROSSOUVRE, 1894 (pl. 24, fig. 2) from the 'calcaires marneux jaunes à *Lima marticensis* situés immédiatement au-dessus des marnes bleues qui se trouvent au bas du chemin de Sougraigne aux Croutets'.

6-8, 11-13. — *Tetragonites epigonus* (KOSSMAT, 1895).
UM SEN-034, from the Upper Santonian *paraplanum* Subzone of la Jouane.

14. — *Saghalinites* sp.
UPST RO 1, from the Middle Santonian *gallicus* Subzone, le Moulin de Sougraigne.

20, 21. — *Gaudryceras mite* (HAUER, 1858).
MNHP R 655, the original of de GROSSOUVRE, 1894 (pl. 26, fig. 4) from the 'marnes bleues à *Mortoniceras texanum* sur le chemin de Sougraigne au Croutets'.

Figures 1, 2, 9, 10, 14-21 are × 1; figures 3-8, 11-13 are × 2.

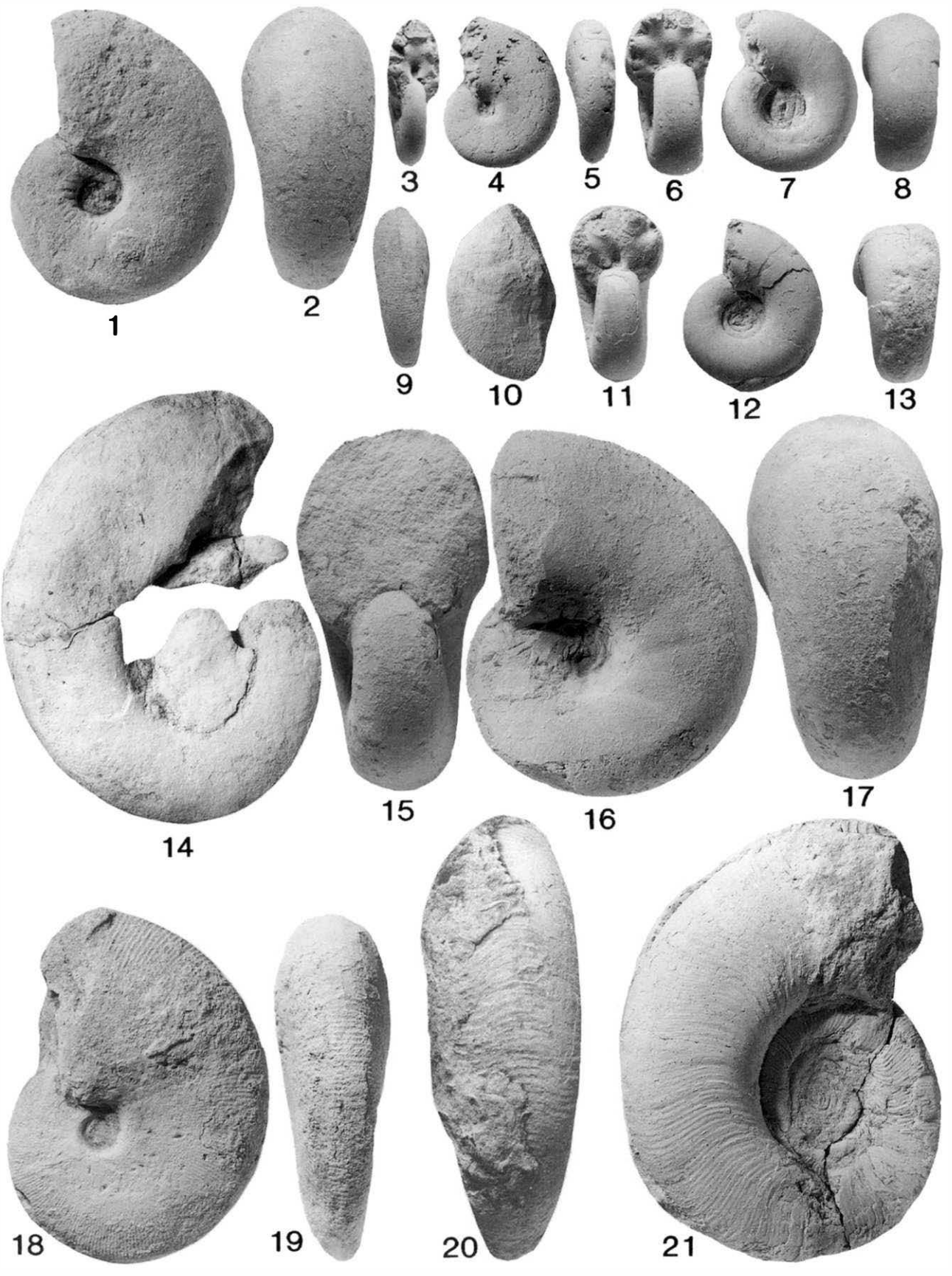
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PLATE 2

Fig. 1-3. — *Gaudryceras denseplicatum* (JIMBO, 1894).
1, 2, PM RO-17; 3, UPST SS25, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

4, 7, 8. — *Gaudryceras varicostatum* VAN HOEPEN, 1921.
UPST 19, from the Middle or the Upper Santonian of Sougraigne.

5, 6. — *Tetragonites epigonus* (KOSSMAT, 1895).
UM SEN-017, from the Turonian, north of Linas, the original of BASSE, 1939 (p. 38).

9. — *Parapuzosia (Parapuzosia) corbarica* (de GROSSOUVRE, 1894).
MNHP R51709, from 'Sougraigne, Rennes-les-Bains'.

10, 11. — *Anagaudryceras* sp.
UPST BO 01, from the Middle to Upper Santonian of Sougraigne.

All figures are x 1.

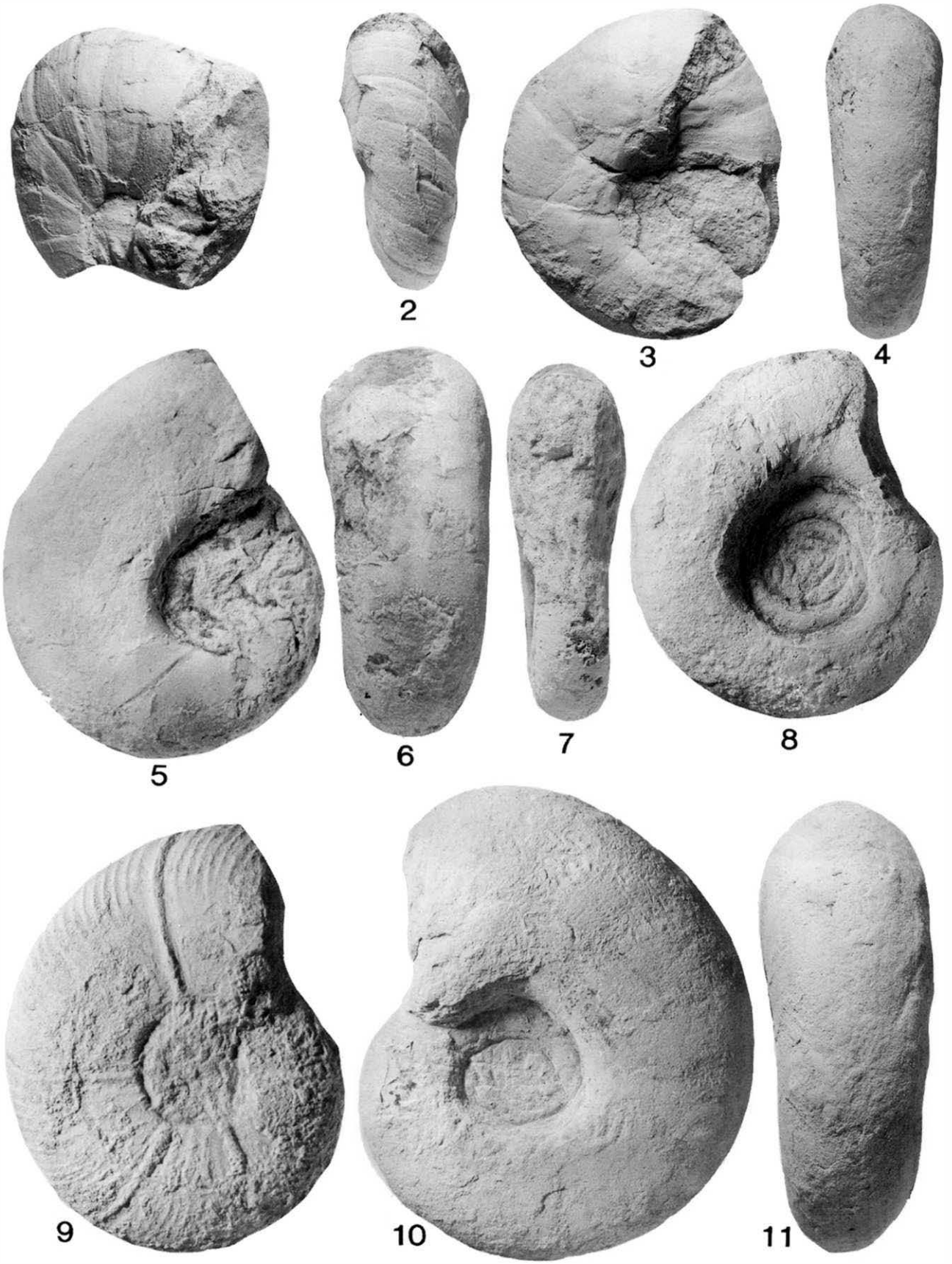
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PLATE 3

Fig. 1, 2. — *Pseudophyllites pyrenaicus* (de GROSSOUVRE, 1894).
PM ST. I, from the Middle Coniacian *tridorsatum* Zone of Soulatgé.

3, 4, 10, 11. — *Saghalinites nuperus* (VAN HOEPEN, 1921).
3, 4, PM A8-4, from the Upper Santonian *paraplanum* Subzone; Chemin de Sougraigne aux Croutets. 10, 11, PM K5-9, from the Middle Santonian *gallicus* Subzone, La Jouane section.

5, 6, 17, 18. — *Damesites sugata* (FORBES, 1846).
5, 6, PM K2 a1, from the Lower Santonian *carezi* Subzone, La Jouane section. 17, 18, UPST M15, from the Lower Santonian of La Montagne de Brenz.

7-9. — *Saghalinites* sp.
7, 8, PM A8-2, from the Upper Santonian *paraplanum* Subzone, Chemin des Croutets. 9, PM F3-1, from the Middle Santonian *gallicus* Subzone of La Montagne de Brenz.

12. — *Hauericeras (Gardeniceras) welschi* de GROSSOUVRE, 1894.
PM L3 S1, from the Middle Santonian *gallicus* Subzone of Les Clemencis.

13-14. — *Tetragonites* cf. *epigonus* (KOSSMAT, 1895).
PM D5-17, from the Middle Santonian *gallicus* Subzone, Ravin de la Coume.

15, 16. — *Gaudryceras denseplicatum* (JIMBO, 1894).
PM NO-8, from the Middle Coniacian *tridorsatum* Zone, Les Bringots.

19, 20. — *Damesites damesi* (JIMBO, 1894) *intermedius* MATSUMOTO, 1954.
UPST L12, from the Lower Santonian *carezi* Subzone, environs of Sougraigne.

All figures are × 1.

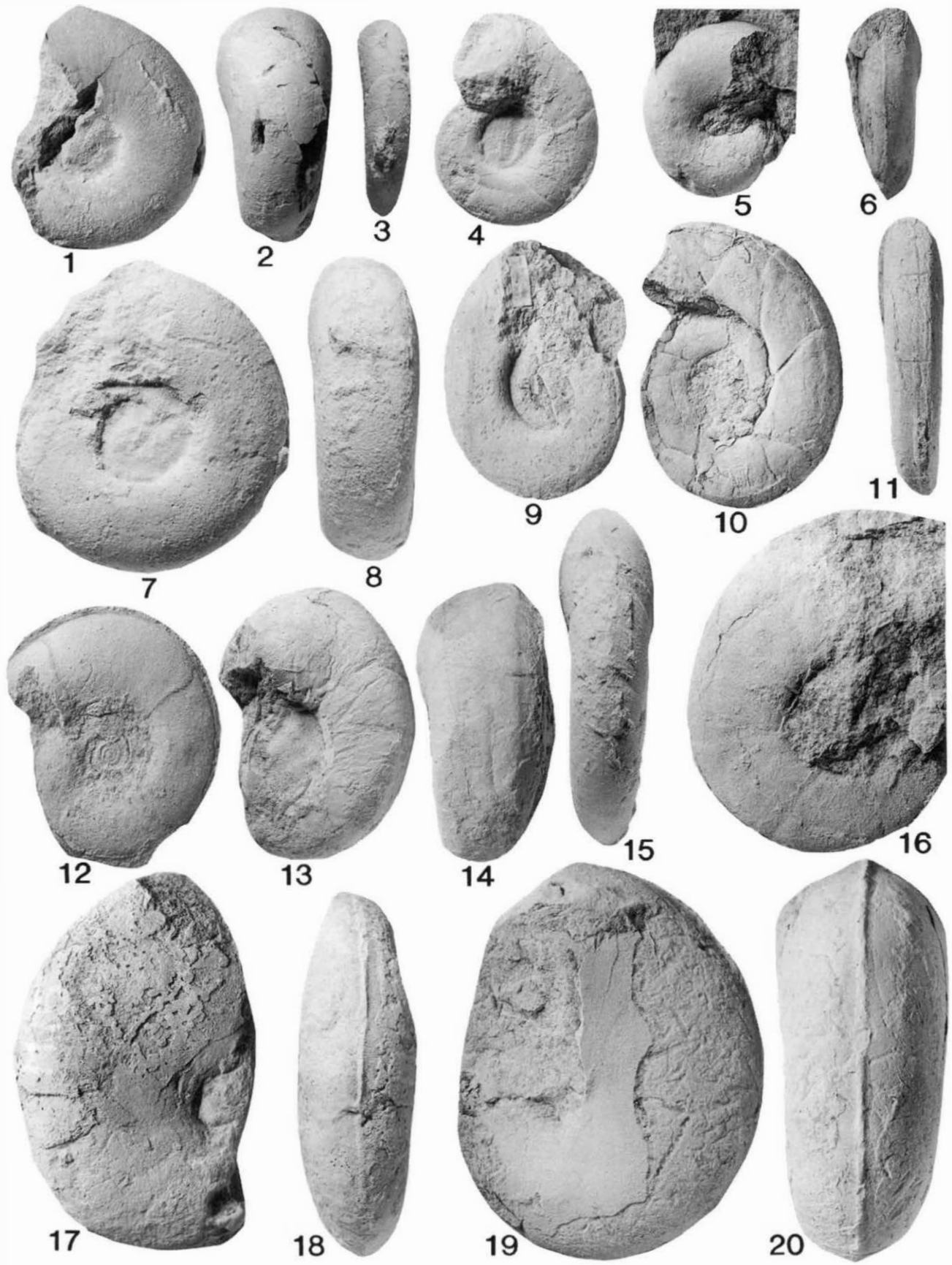
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PLATE 4

Fig. 1, 2, 6, 7. — *Desmophyllites diphylloides* (FORBES, 1846).
1,2, UPST 32 : 6, 7, UM SEN-042, both from the Upper Santonian *paraplanum* Subzone, La Jouane.

3, 5. — *Hauericeras (Gardeniceras) welschi* de GROSSOUVRE, 1984.
3, UPST, Upper Santonian *paraplanum* Subzone, La Jouane; 4, 5, UM SEN-309, the original of BASSE, 1939 (pl. 3, fig. 9) from the Upper Santonian *paraplanum* Subzone, La Jouane.

8-11, 15, 16. — *Jimboiceras* ? *reyi* COLLIGNON, 1983.
8, 9, PM RO-02, from the Middle Coniacian *tridorsatum* Zone; 10, 11, PM RO-18, from the Upper Coniacian *margae* Zone; 15, 16, the holotype, UPST M22, from the Middle Coniacian *tridorsatum* Zone, all from Les Pastressis.

12, 13. — *Gaudryceras denseplicatum* (JIMBO, 1894).
PM NO-8, from the Middle Coniacian *tridorsatum* Zone, Les Bringots.

17. — *Hauericeras lagarum* (REDTENBACHER, 1873).
PM LOa1, from the Middle Coniacian *tridorsatum* Zone, Source des Tourtes.

18-20. — *Jimboiceras* ? sp.
PM SO-1 from the Middle Coniacian *tridorsatum* Zone, west of Soulatgé.

21. — *Damesites sugata* (FORBES, 1846).
UPST S21, from the Lower Santonian *carezi* Subzone, north of La Montagne de Brenz.

Figures 1, 2, 6, 7 are × 2; fig. 3 is × 4; fig. 4, 5, 8-21 are × 1.

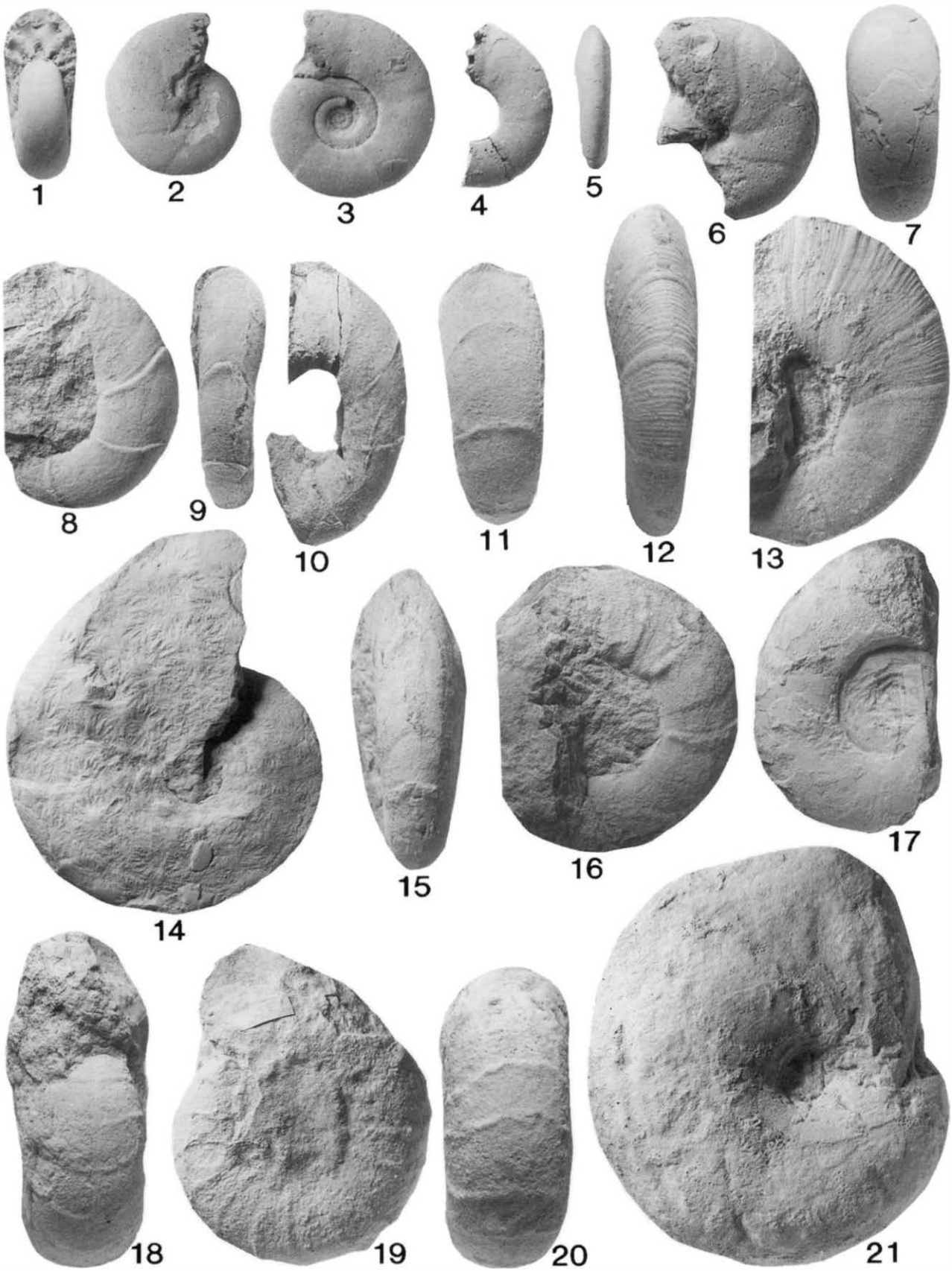
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PLATE 5

Fig. 1-3. — *Parapuzosia (Parapuzosia) corbarica* (de Grossouvre, 1849).
SP unregistered, *ex* Toucas Collection, 'Santonien supérieur, Sougraigne'.

4-8. — *Parapuzosia (Parapuzosia)* sp.
4, 8, UPST C1; 5, 6, UPST C2, all from the Lower Santonian *carezi* Subzone, Rouffiac. 7, PM PNIX, from the Lower Coniacian *petrocoriensis* Zone, Peyrefitte.

All figures are × 1.

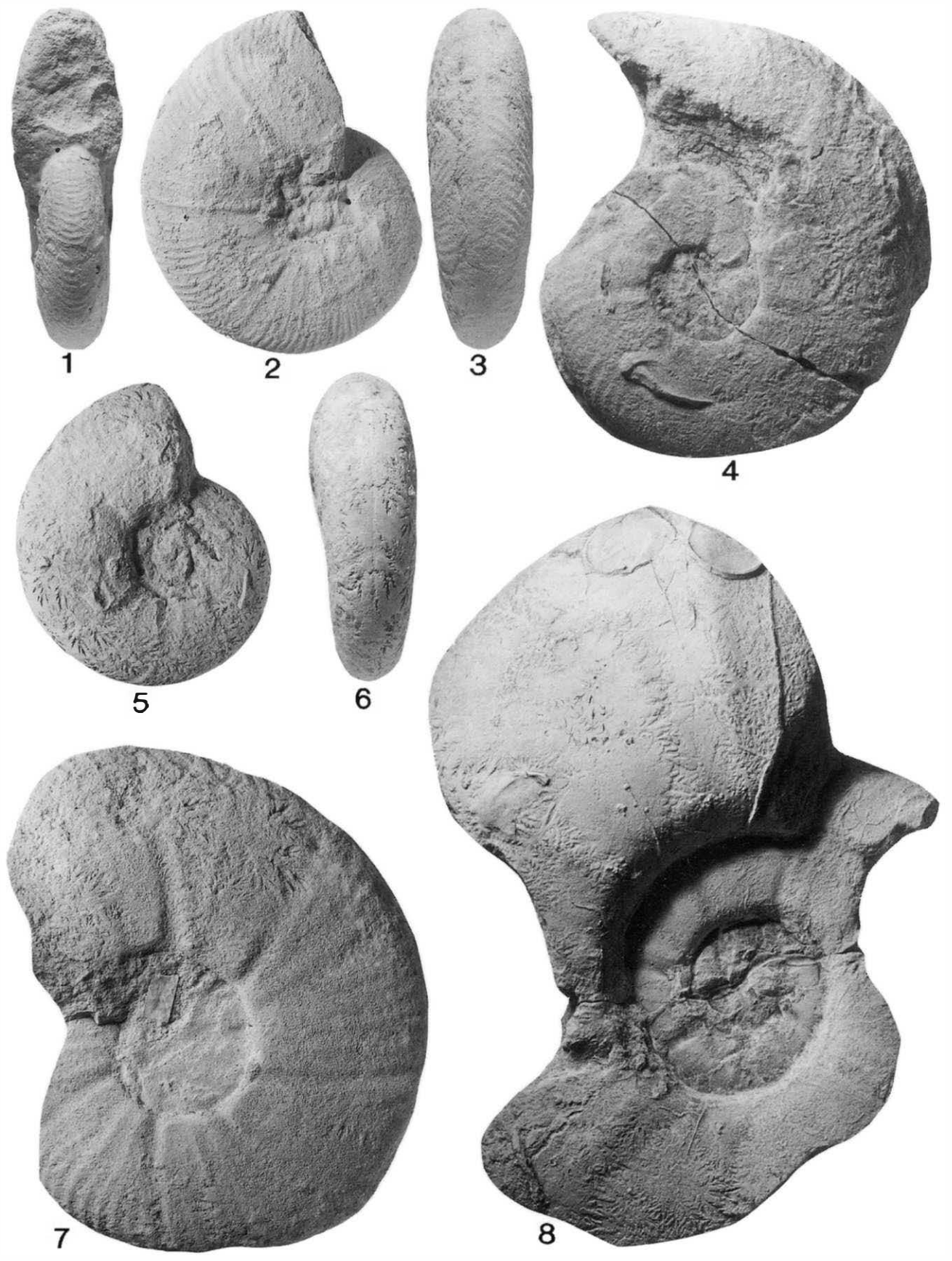
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PLATE 6

Fig. 1-2. — *Jimboiceras* ? *reyi* COLLIGNON, 1983.
PM P1-14, from the Upper Coniacian *margae* Zone, west of the Col du Linas.

3, 6-8, 11, 12. — *Nowakites carezi* (de GROSSOUVRE, 1894).
3, PM G5c5, from the Middle Santonian *gallicus* Subzone, left bank of River Sals at Sougraigne. 6, PM K1c19 and 7, 8, PM K1c10, from the Lower Santonian *carezi* Subzone, La Jouane section. 11, 12, UPST 12, from the Lower Santonian *carezi* Subzone, environs of Sougraigne.

4, 5. — *Nowakites* aff. *katschthaleri* (IMMEL, KLINGER & WIEDMANN, 1982).
PM K1c 20, from the Lower Santonian *carezi* Subzone, La Jouane section.

9, 10, 22, 23. — Pachydiscid microconch.
OUM KZ 20714, from the Moulin d'Amont, east of Sougraigne.

13, 14. — *Nowakites* sp. microconch.
PM P1-16, from the Upper Coniacian *margae* Zone, west of the Col du Linas.

15-19. — *Nowakites talavignesii* (d'ORBIGNY, 1850).
15, 16, OUM KZ 20706, Santonian, Pont de Montferrand. 17-19, holotype, FSL A1695, *ex* Ecole des Mines Collection nº 1568, the original of d'ORBIGNY, 1850, and COLLIGNON, 1952 (pl. 9, fig. 3) from 'Au-dessous des Hippurites, Rennes-les-Bains, Aude'.

20, 21, 24. — *Nowakites pailletteanus* (d'ORBIGNY, 1841).
SP unregistered, *ex* TOUCAS Collection, 'Coniacien supérieur, ravin de Montferrand, Montagne des Cornes'.

Figures 1-8, 11-14, are × 1; Fig. 9, 10 are × 2.

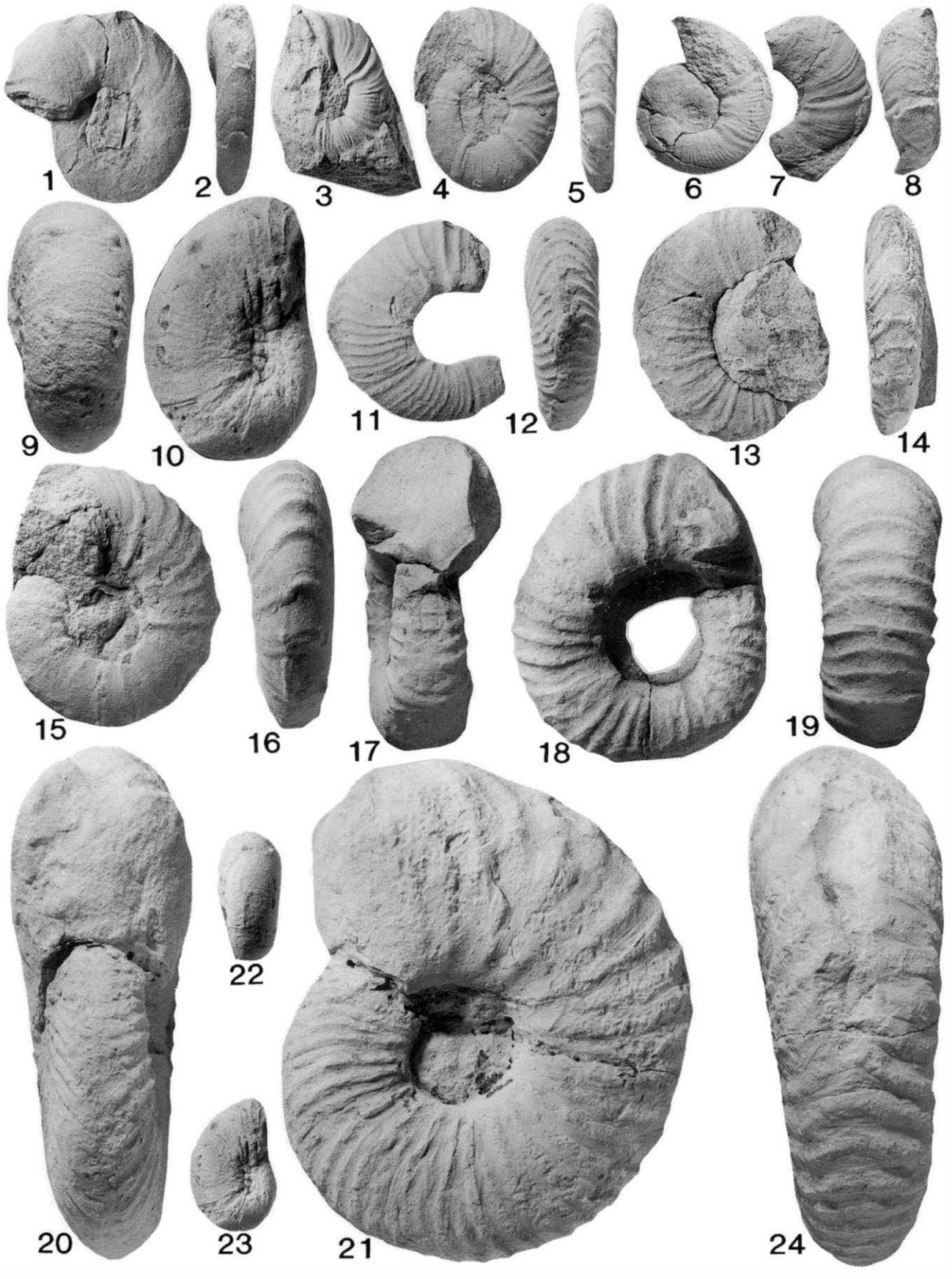
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PLATE 7

Fig. 1-3, 6-12. — *Nowakites pailletteanus* (d'Orbigny, 1841).
1-3, the holotype, by monotypy, of *Nowakites lemarchandi* de Grossouvre 1894.
MNHP *ex* Peron Collection 1908-36, the original of de Grossouvre 1894 (pl. 22, fig. 5) from the 'Calcaires durs de la base de l'étage Coniacien. Environs de Montferrand'. 6, 7, paralectotype, 9, 10, lectotype, MNHP d'Orbigny Collection 7187, from 'entre Soulatge et la Source Salée'. 8, 11, 12, MNHP Collections, Marnes à Micraster, Moulin du Ruisseau de Sals à l'est de Sougraigne'.

4, 5. — *Nowakites carezi* (de Grossouvre, 1894).
PM K2a18, from the Lower Santonian *carezi* Subzone, La Jouane section.

All figures are × 1.

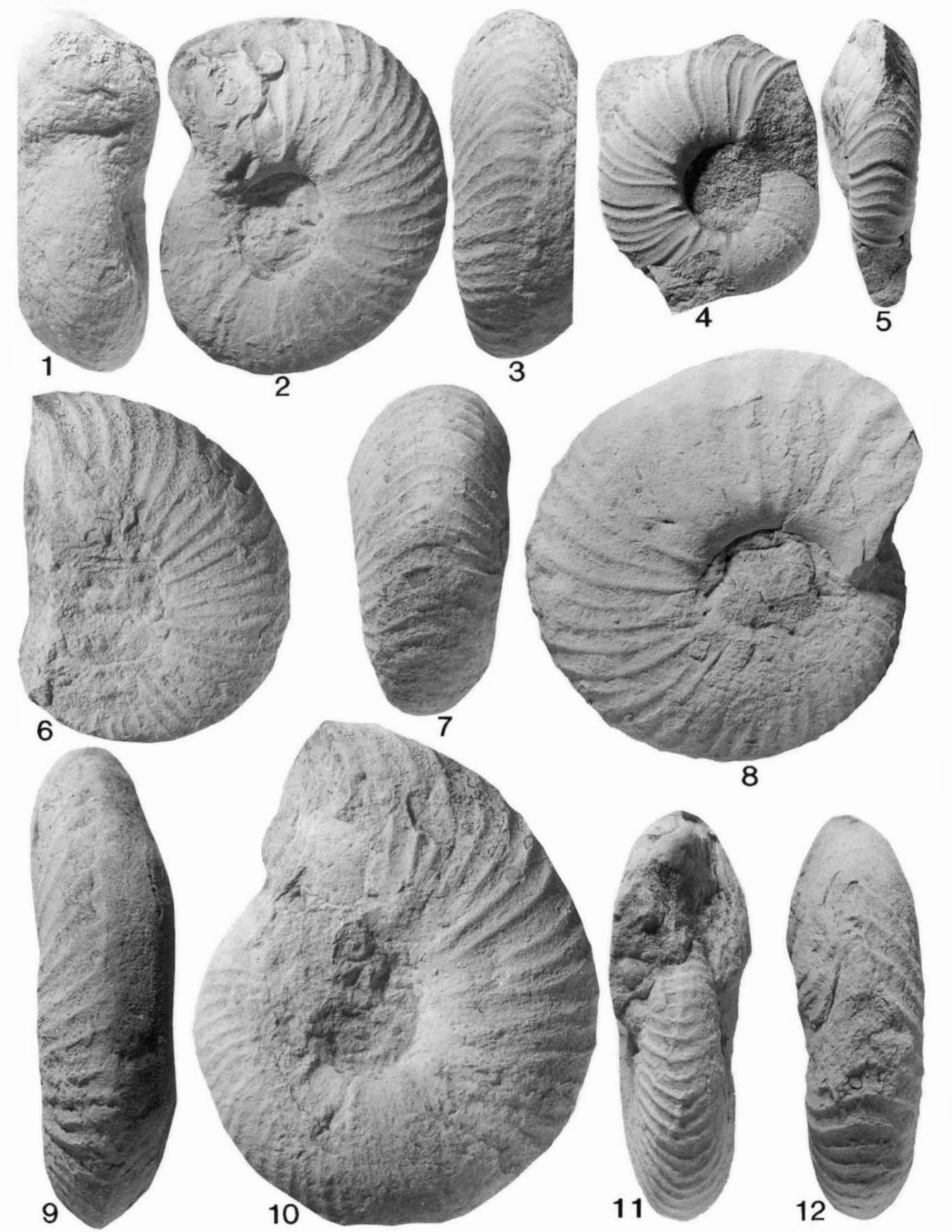
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PLATE 8

Fig. 1-5, 8-12. — *Nowakites talavignesii* (d'Orbigny, 1850).
1-5, MNHP unregistered, environs de Sougraigne, *ex* de Grossouvre Collection. 8-12, MNHP unregistered environs de Sougraigne, *ex* de Grossouvre Collection.

6-7. — *Nowakites* sp.
Pathological specimen, MNHP unregistered, Sougraigne, *ex* de Grossouvre Collection.

13-15. — *Nowakites carezi* (de Grossouvre, 1894).
13, PM B2-4, from the Lower Santonian *carezi* Subzone, Ravin de la Coume. 14-15, UPST S5, from the Middle Santonian *gallicus* Subzone, environs of Sougraigne.

16-23. — *Nowakites savini* (de Grossouvre, 1984).
16, 17, MNHP unregistered, *ex* de Grossouvre Collection, from Sougraigne. 18, UPST MB01, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume. 19, 20, MNHP B17445a, Sougraigne. 21-23, MNHP unregistered, without locality, but clearly from the environs of Sougraigne.

All figures are × 1.

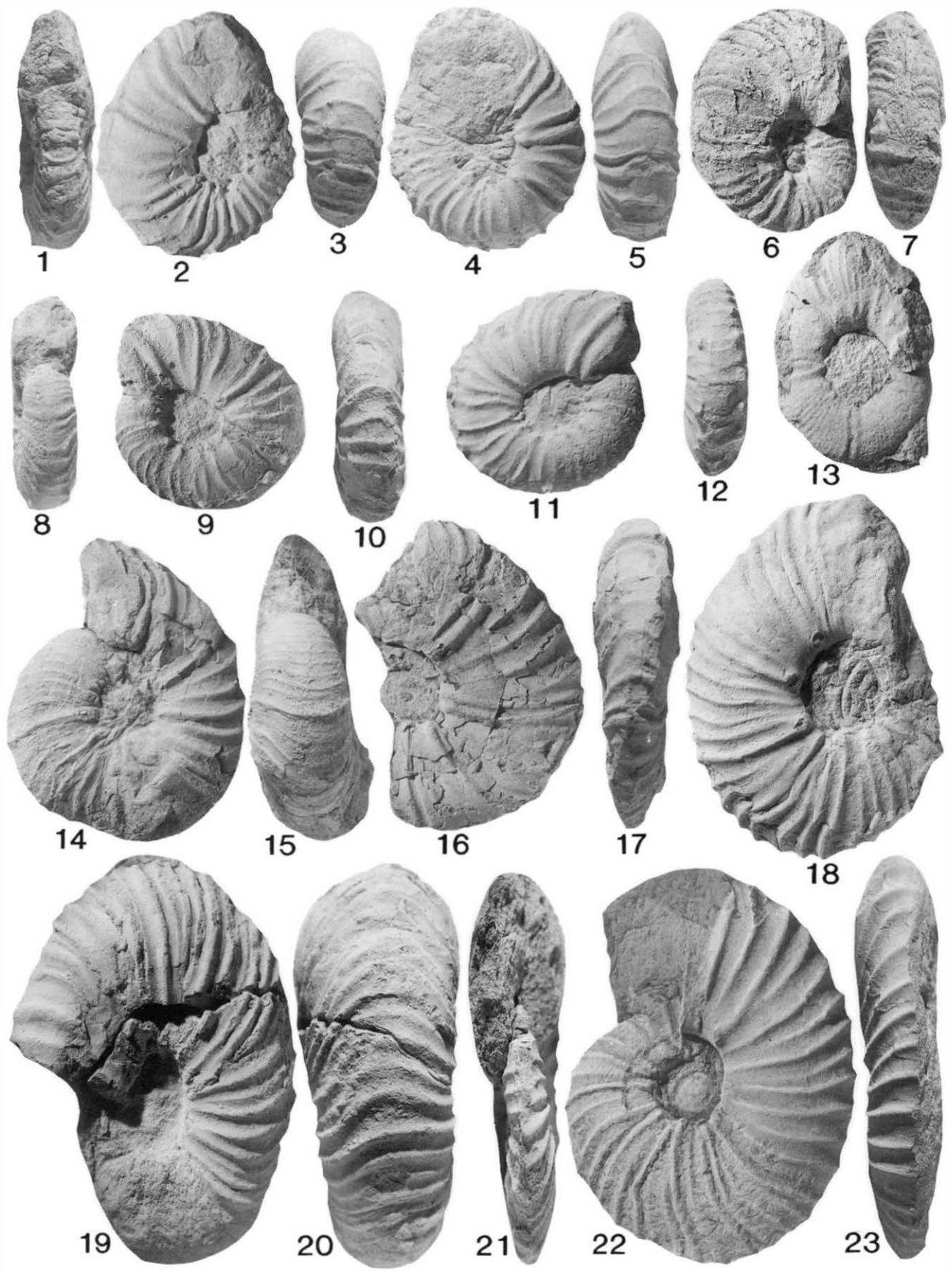
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PLATE 9

Fig. 1, 6, 7. — *Nowakites savini* (de GROSSOUVRE, 1894).
1, PM M2b1, from the Lower Santonian *carezi* Subzone, Les Clemencis. 6-7, UPST LS1, from the Middle Santonian *gallicus* Subzone, nouveau cimetière de Sougraigne.

2, 3-4. — *Nowakites carezi* (de GROSSOUVRE, 1894).
Holotype, MNHP unregistered, the original of de GROSSOUVRE, 1894 (pl. 25, fig. 3) from the 'Couches à Micrasters des environs de Rennes-les-Bains'.

5. — *Nowakites* aff. *pailletteanus* (d'ORBIGNY, 1841).
PM RO-2, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

8. — *Nowakites pailletteanus* (d'ORBIGNY, 1841).
PM P1-23, from the Middle Coniacian *tridorsatum* Zone, west of the Col du Linas.

9, 10. — *Eupachydiscus isculensis* (REDTENBACHER, 1873).
PM M4-3, from the Middle Santonian *gallicus* Subzone, Les Clemencis.

All figures are × 1.

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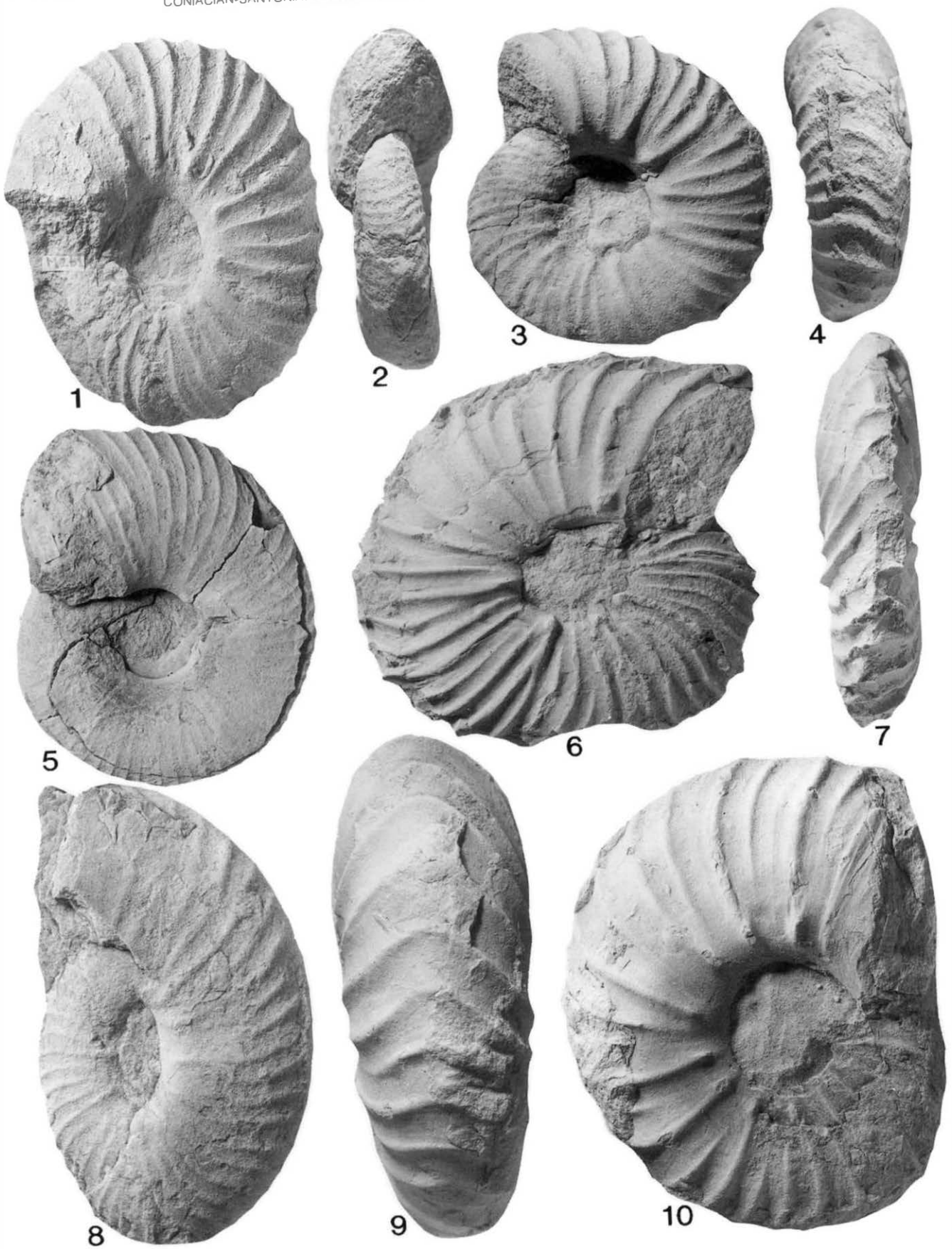

PLATE 10

Fig. 1-6, 9-11. — Pachydiscid juveniles.
PM M4, from the Lower Santonian *carezi* Subzone, Les Clemencis.

7, 8. — Juvenile desmoceratacean, the original of *Parapuzosia gaudama* FORBES of BASSE, 1939 (pl. 3, fig. 10)
UM SEN-040, from the Upper Santonian *paraplanum* Subzone of La Jouane.

12. — *Eupachydiscus isculensis* (REDTENBACHER, 1873).
PM B4-1, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

13-15. — *Tongoboryceras canali* (de GROSSOUVRE, 1894).
13, MNHP B17444, 'Environs de St. Louis'. 14, 15, PM PNIV, from the Lower Coniacian *petrocoriensis* Zone, Peyrefitte.

16. — *Nowakites pailletteanus* (d'ORBIGNY, 1841).
PM RO-34, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

Figures 1-11 are × 2; fig. 12-16 are × 1.

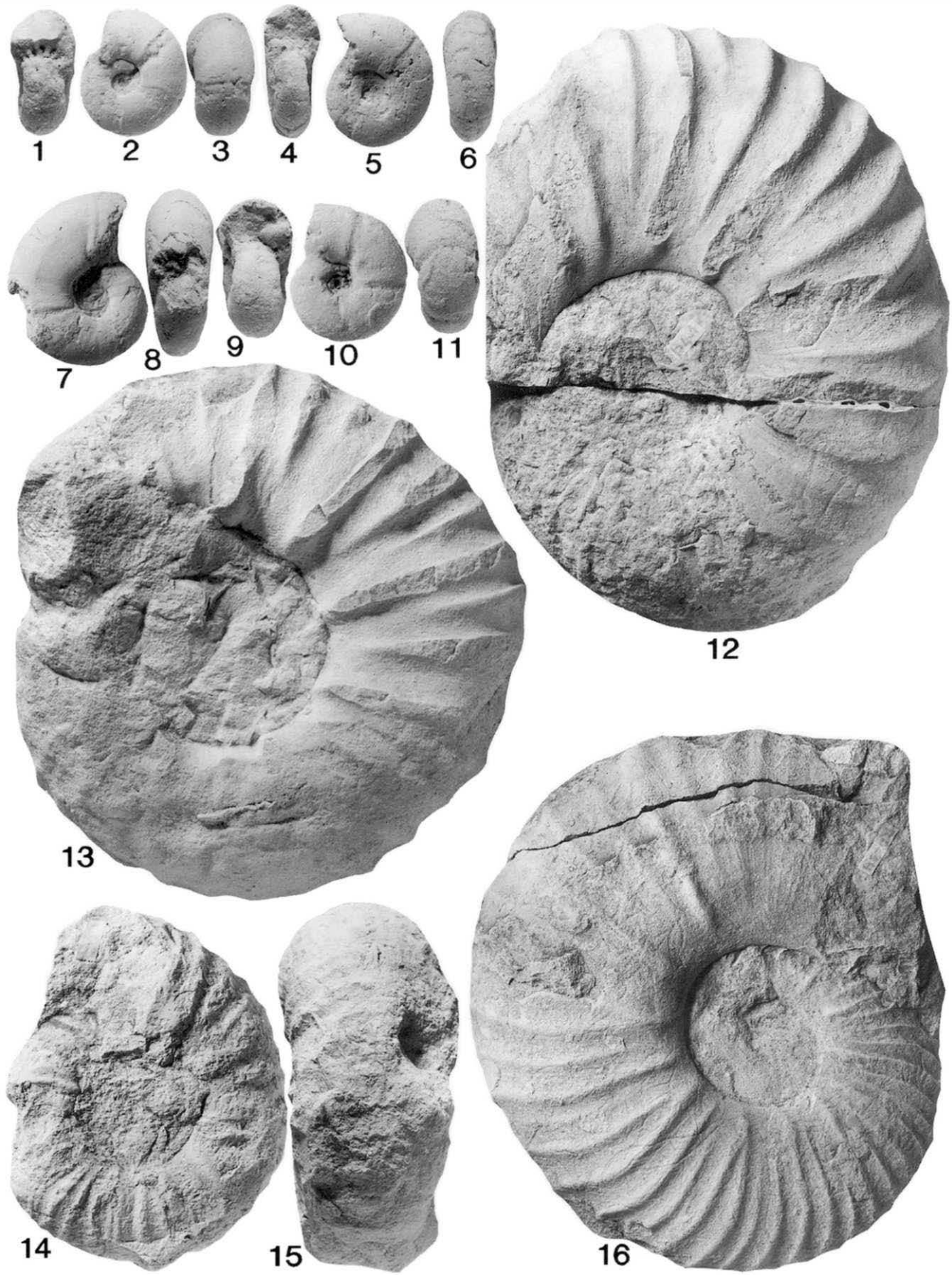
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PLATE 11

Fig. 1-3, 5-8. — *Eupachydiscus isculensis* (REDTENBACHER, 1873).
1-3, MNHP R51882, the original of de GROSSOUVRE, 1894 (pl. 37, fig. 1) from the 'Marnes ferrugineuses à *Placenticeras syrtale*, comprises entre les deux bancs inférieurs de rudistes du chemin de Sougraigne aux Croutets'. 5, 6, PM K3S6, from the Middle Santonian *gallicus* Subzone, La Jouane section. 7, 8, UPST 2, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

4. — *Nowakites* aff. *pailletteanus* (d'ORBIGNY, 1841).
PM P1-24, from the Upper Coniacian *margae* Zone, west of Le Col du Linas.

9-11. — *Pachydiscus (Pachydiscus) cayeuxi* de GROSSOUVRE, 1894.
MNHP R51867, holotype, the original of de GROSSOUVRE, 1894 (pl. 36, fig. 3) from the 'marnes ferrugineuses intercalées entre les bancs inférieurs de rudistes, sur le chemin de Sougraigne aux Croutets'.

All figures are × 1.

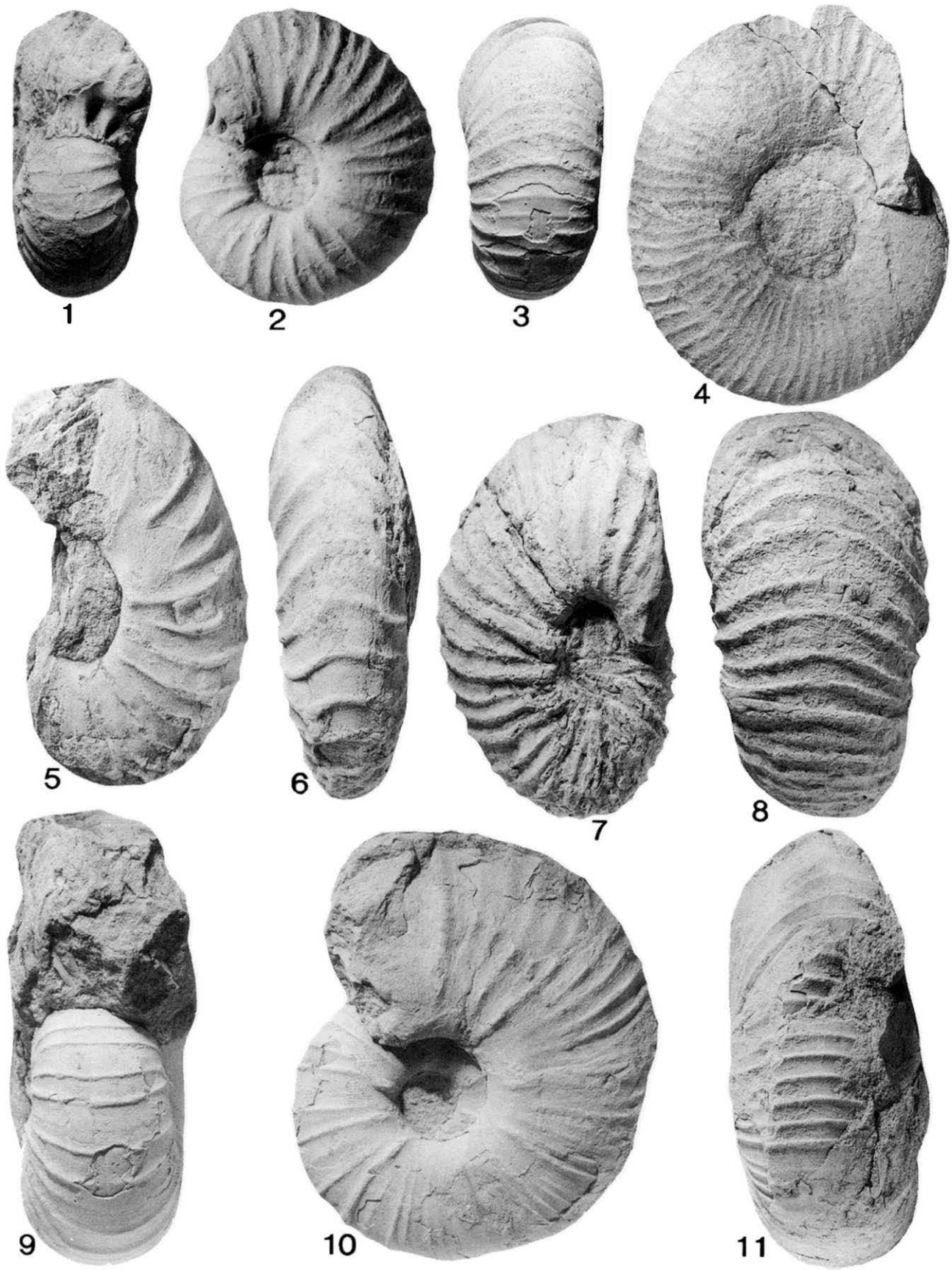
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PLATE 12

Fig. 1-6. — *Pachydiscus (Pachydiscus) jeani* de Grossouvre, 1894.
1-3, SP unregistered *ex* Toucas Collection, 'Moulin Tiffou'. 4-6, SP unregistered *ex* Toucas Collection, Sougraigne.

All figures × 1.

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PLATE 13

Fig. 1, 5, 6, 9, 13, 14. — *Texasia rivierae* (COLLIGNON, 1983).
1, PM K2b47, from the Lower Santonian *carezi* Subzone, La Jouane section. 5, 6, UPST BO02, the holotype of *Praemuniericeras boriesi* COLLIGNON, 1983 (pl. 3, fig. 1) from the Lower Santonian *carezi* Subzone, environs de Sougraigne. 9, PM K2b53, from the Lower Santonian *carezi* Subzone, La Jouane section. 13, 14, the holotype, UPST R02, from the Lower Santonian *carezi* Subzone, Claparayde.

2, 4, 10. — *Muniericeras bilottei* (COLLIGNON, 1983).
2, holotype, UPST S16, the original of COLLIGNON, 1983 (pl. 3, fig. 2) from the 'chemin de Sougraigne aux Croutets'. 4, UPST MB S24, the original of COLLIGNON, 1983 (pl. 3, fig. 4) from the Middle Santonian *gallicus* Subzone, east of La Montagne de Brenz. 10, UPST S17, the original of COLLIGNON, 1983 (pl. 3, fig. 3) from the Middle Santonian *gallicus* Subzone, environs de Sougraigne.

3. — *Muniericeras* sp. juv. UPST S23, the original of *Praemuniericeras* aff. *subgosauicum* of COLLIGNON, 1983 (pl. 3, fig. 5) from the Middle Santonian *gallicus* Subzone, east of La Montagne de Brenz.

7, 8. — *Pseudoschloenbachia (Pseudoschloenbachia)* aff. *umbulazi* (BAILY, 1855).
PM H5-11, from the Middle Santonian *gallicus* Subzone, east of La Montagne de Brenz.

11, 12, 15. — *Muniericeras lapparenti* (de GROSSOUVRE, 1894).
11, 12, holotype, MNHP unregistered, the original of de GROSSOUVRE, 1894 (pl. 29, fig. 1) from the 'couches sénoniennes inférieures des environs de Bugarach'. 15, SP M949, the original of de GROSSOUVRE, 1894 (pl. 29, fig. 5) from the 'Calcaires à micrasters, côté droit du chemin de Rennes-les-Bains à Montferrand'.

All figures are × 1.

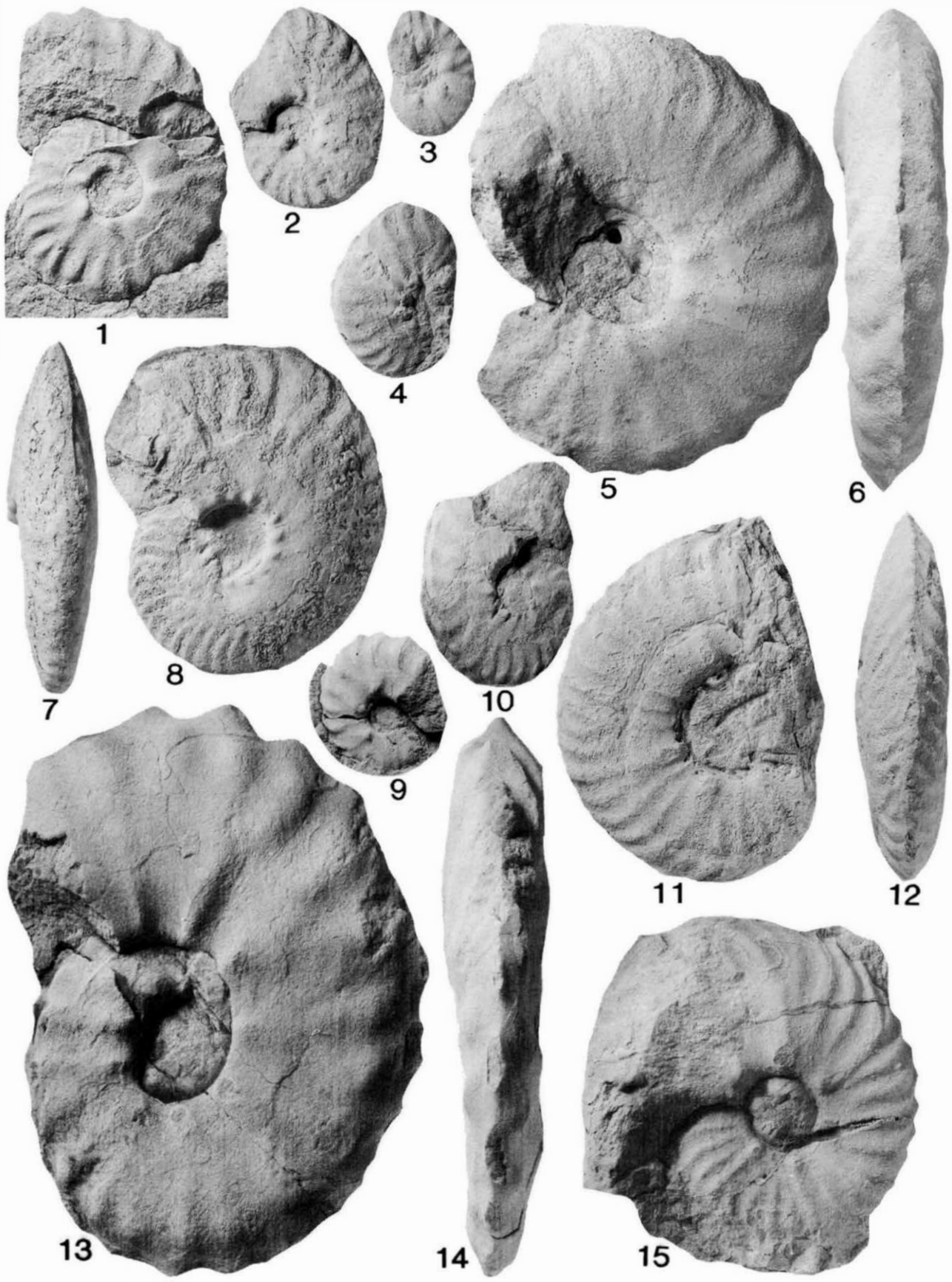
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PLATE 14

Fig. 1, 4, 5, 17. — *Pseudoschloenbachia (Pseudoschloenbachia) bertrandi* (de GROSSOUVRE, 1894).
1, PM K6-1, from the Middle Santonian *gallicus* Subzone, La Jouane section. 4, PM G6-10. 5, PM G6-12, all from the Upper Santonian *paraplanum* Subzone, left bank of River Sals at Sougraigne. 17, holotype, MNHP unregistered, the original of de GROSSOUVRE, 1894 (pl. 38, fig. 1) from the 'Marnes bleues du ravin situées au nord de Sougraigne'.

2, 3, 10, 11. — *Muniericeras bilottei* (COLLIGNON, 1983).
2, PM D5-10, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume. 3, PM G5b4, from the Middle Santonian *gallicus* Subzone, left bank of the River Sals at Sougraigne. 10, 11, PM D5 ?, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

6, 14. — *Pseudoschloenbachia (Pseudoschloenbachia)* gr. *umbulazi* (BAILY, 1855). 6, UPST 16, the original of *Pseudoschloenbachia bertrandi* of COLLIGNON, 1983 (pl. 4, fig. 8). 14, PM G6-15) from the Upper Santonian *paraplanum* Subzone, left bank of River Sals at Sougraigne.

7, 8, 12, 13. — *Pseudoschloenbachia (Pseudoschloenbachia) inconstans* (de GROSSOUVRE, 1894).
7, PM K2b33 and 8, PM K2b30, from the Lower Santonian *carezi* Subzone. 12, 13, PM K4a1, from the Middle Santonian *gallicus* Subzone, all from the La Jouane section.

9. — *Hemitissotia randoi* GERTH, 1961.
PM K3, from the Middle Santonian *gallicus* Subzone, La Jouane section.

15, 16. — *Pseudoschloenbachia (Pseudoschloenbachia) casterasi* COLLIGNON, 1983.
Holotype, UPST 12 PR, from the Lower Santonian *carezi* Subzone, Les Pastressis.

All figures are × 1.

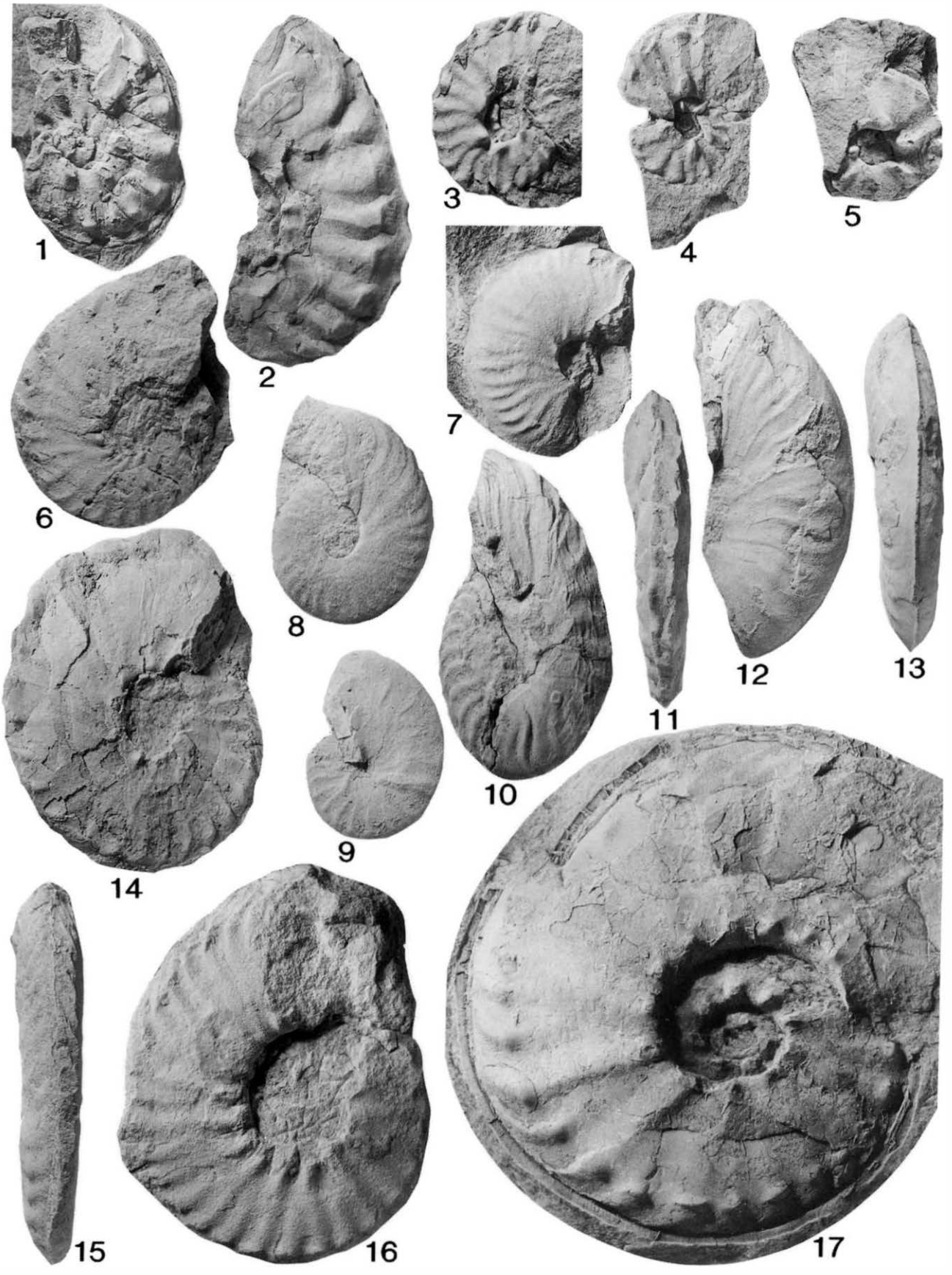
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PLATE 15

Fig. 1-6, 13-16. — *Pseudoschloenbachia (Pseudoschloenbachia) inconstans* (de GROSSOUVRE, 1894).
1, 2, MNHP R52608, the original of COLLIGNON, 1983 (pl. 4, fig. 5) from 'Montferrand, près Rennes-les-Bains'. 3, 4, MNHP R52611, the original of COLLIGNON, 1983 (pl. 4, fig. 3) from the Santonian of Aude. 5, 6, MNHP R52607, the original of COLLIGNON, 1983 (pl. 4, fig. 4) from Montferrand. 14, 15, lectotype MNHP R52609, the original of de GROSSOUVRE, 1894 (pl. 35, fig. 5) from the 'calcaires marneux à la base des couches à micrasters. Ravin de Montferrand'. 16, MNHP 52610, paralectotype, the original of de GROSSOUVRE, 1894 (pl. 25, fig. 4) horizon and locality as for 14, 15.

7, 8, 19. — *Pseudoschloenbachia (Pseudoschloenbachia) grossouvrei* sp. nov.
8, 19, holotype, MNHP unregistered, the original of de GROSSOUVRE, 1894 (pl. 29, fig. 6) paralectotype of *P. (P.) bertrandi*, from the 'calcaires marneux jaunes à *Lima marticensis,* situés immédiatement au-dessus des marnes bleues à *Mortoniceras texanum*, sur le chemin de Sougraigne aux Croutets'. 7, SP, *ex* TOUCAS Collection, from Sougraigne.

9. — *Hemitissotia randoi* GERTH, 1961.
PM K3S4, from the Middle Santonian *gallicus* Subzone, La Jouane section.

10-12. — *Pseudobarroisiceras rennense* (de GROSSOUVRE, 1894).
10, 11, Holotype, MNHP unregistered, the original of de GROSSOUVRE, 1894 (pl. 35, fig. 2) from the 'calcaires marneux à la base des couches à Micrasters. Ravin de Montferrand'. 12, SP unregistered 'entre Bugarach et les Linas, sur le côté droit de la route près Linas. Marnes à *Micraster*'.

17, 18. — *Gauthiericeras nouelianum* (d'ORBIGNY, 1850).
UPST S3, the original of *Pseudoschloenbachia (Fournierella)* aff. *praefournieri* of COLLIGNON, 1983 (pl. 5, fig. 1) from the Middle Coniacian *tridorsatum* Zone, Ravin de La Douce.

20. — *Muniericeras lapparenti* de GROSSOUVRE, 1894.
PM K2a11, from the Lower Santonian *carezi* Subzone, La Jouane section.

All figures are × 1.

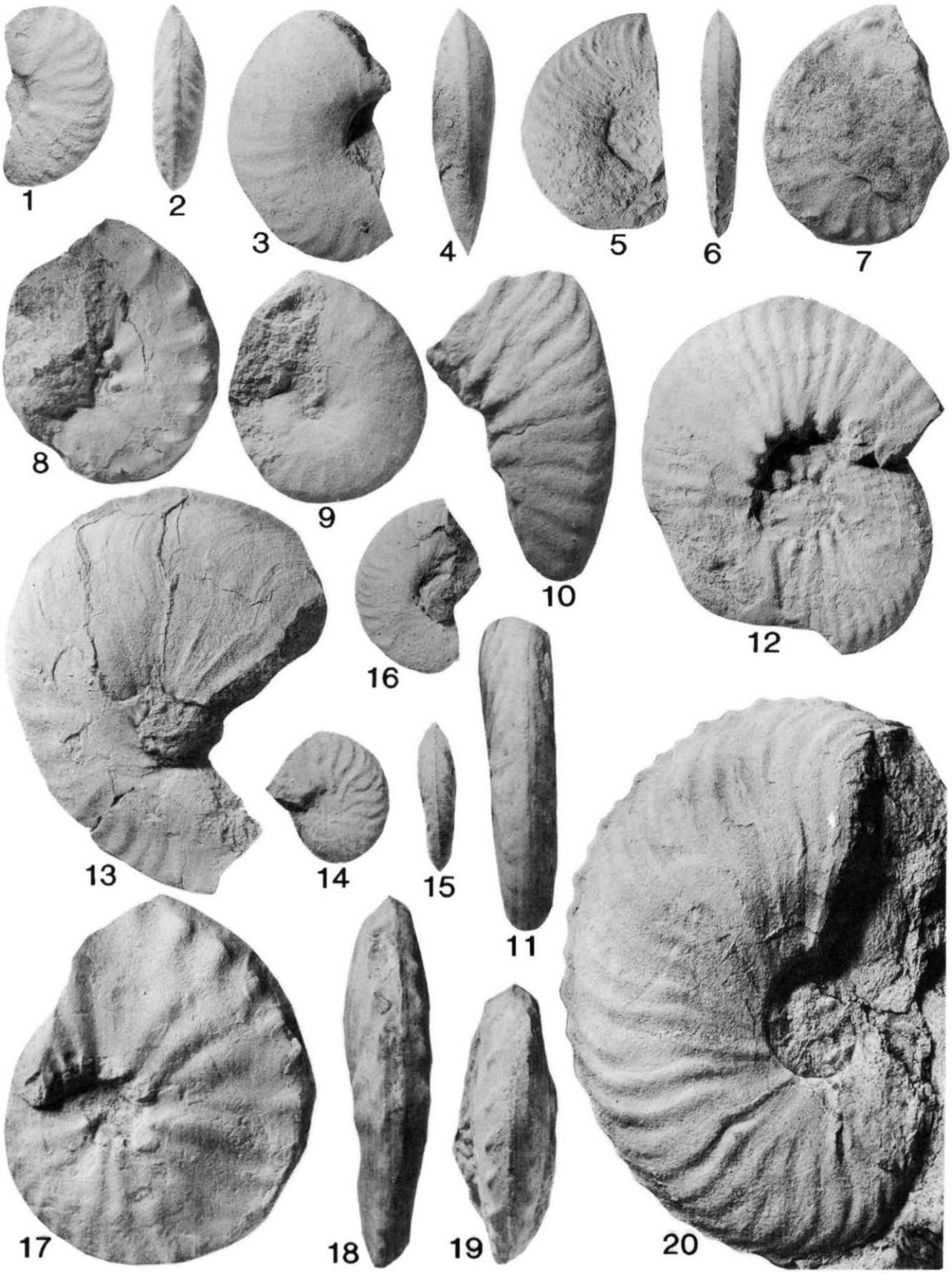
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PLATE 16

Fig. 1, 2, 11. — *Pseubarroisiceras rennense* (de GROSSOUVRE, 1894).
1, 2, PM RO-25; 11, PM RO-5, all from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

3, 8, 9. — *Pseudoschloenbachia (Pseudoschloenbachia) inconstans* (de GROSSOUVRE, 1894).
3, PM H5-9, from the Middle Santonian *gallicus* Subzone, east of La Montagne de Brenz. 8, PM B5-1, from the Middle Santonian *gallicus* Subzone, Ravin de la Coume; 9, PM K2c1, from the Lower Santonian *carezi* Subzone, La Jouane section.

4, 5, 6, 7, 10. — *Muniericeras lapparenti* (de GROSSOUVRE, 1894).
4, 5, PM K2a8, from the Lower Santonian *carezi* Subzone, La Jouane section. 6, 7, FSL 14106, from Sougraigne. 10, PM B5-36, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

All figures are × 1.

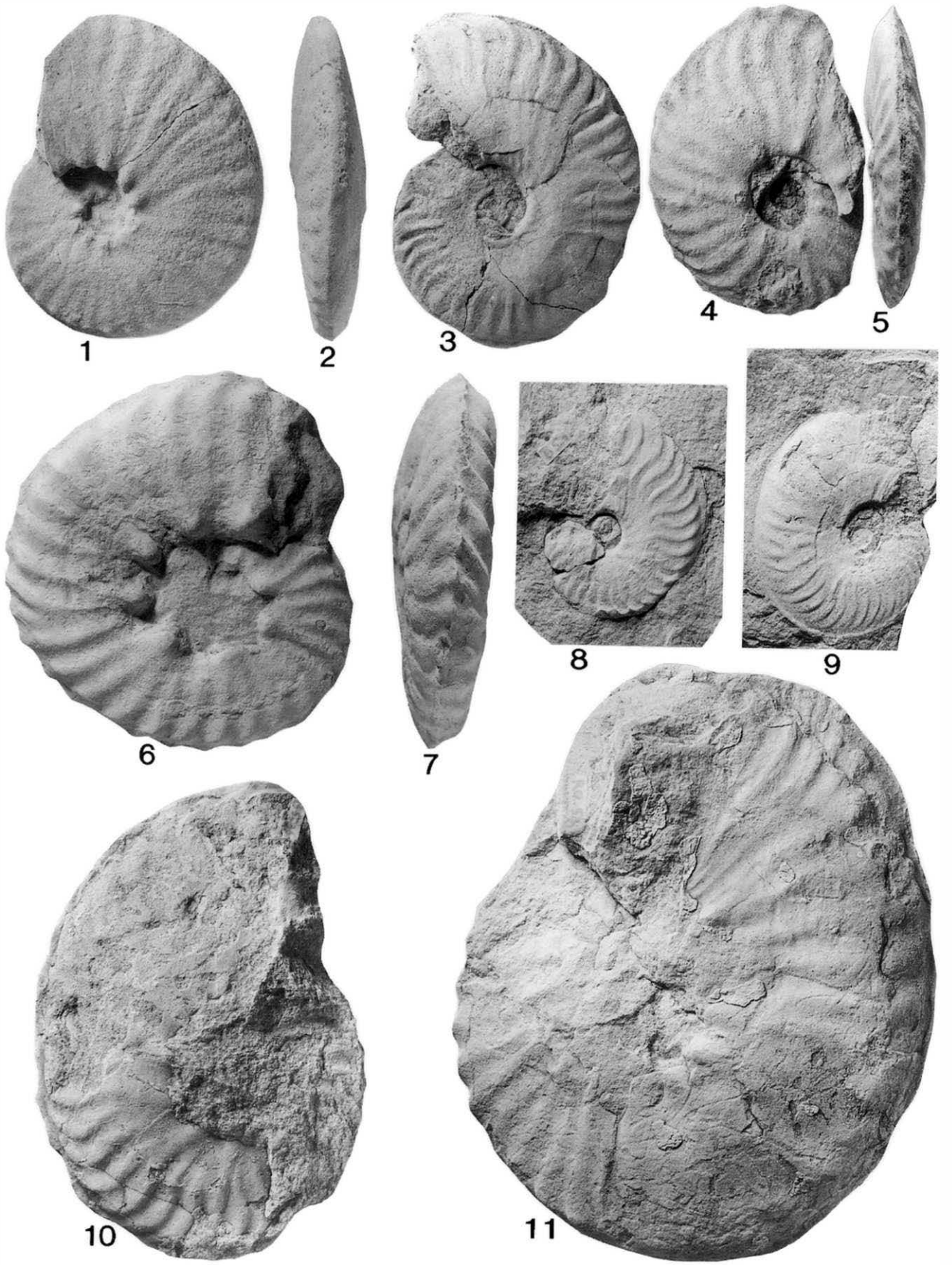
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PLATE 17

Fig. 1. — *Muniericeras bilottei* (COLLIGNON, 1983).
PM D5-5, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

2-7, 9-10. — *Placenticeras polyopsis* (DUJARDIN, 1837).
2, 3, PM A8-14, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. 4, 5, UPST MB21, the original of COLLIGNON, 1983 (pl. 6, fig. 1) from the Upper Santonian *paraplanum* Subzone, Montagne de Brenz. 6, 7, PM A10-8, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. 9, 10, UPST MB31, from the Upper Santonian *paraplanum* Subzone, La Jouane.

8. — *Placenticeras* cf. *paraplanum* WIEDMANN, 1978.
PM G6-20, from the Upper Santonian *paraplanum* Subzone, left bank of River Sals at Sougraigne.

11, 12. — *Placenticeras paraplanum* WIEDMANN, 1978.
UPST S4, the original of COLLIGNON, 1983 (pl. 5, fig. 2) from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

All figures are × 1.

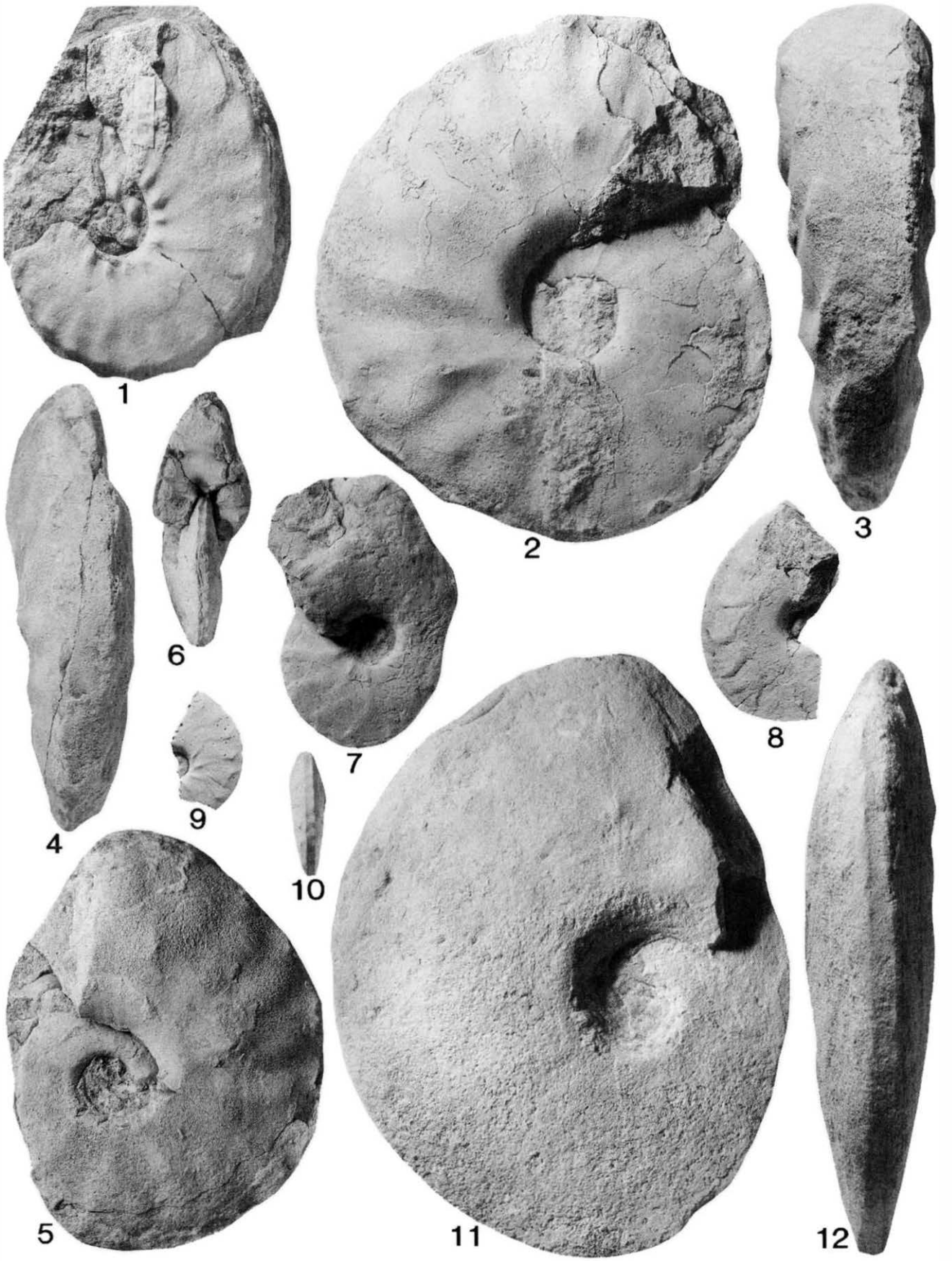
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PLATE 18

Fig. 1-4. — *Placenticeras paraplanum* WIEDMANN, 1978.
1, 2, SP unregistered *ex* TOUCAS Collection, from the 'Marnes à *Lima marticensis* au-dessus du banc à *Hipp. sublaevis*, colline du cimetière de Sougraigne'. 3, 4, PM H5-7, from the Upper Santonian *paraplanum* Subzone, east of La Montagne de Brenz.

5. — *Metatissotia ewaldi* (VON BUCH, 1848).
PM BOa4, from the Middle Coniacian *tridorsatum* Zone, Ravin de La Coume.

6. — *Pseudoschloenbachia (Pseudoschloenbachia) bertrandi* (de GROSSOUVRE, 1894).
UPST S14, the original of COLLIGNON, 1983 (pl. 2, fig. 5) from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

7-12. — *Placenticeras polyopsis* (DUJARDIN, 1837).
7, 8, UM SEN-043a. 9, 10, UM SEN-043b, from the Upper Santonian *paraplanum* Subzone of La Jouane. 11, 12, SP unregistered, the original of de GROSSOUVRE, 1894 (pl. 7, fig. 1) from the 'marnes ferrugineuses intercalées entre les bancs de rudistes sur le chemin de Sougraigne aux Croutets'.

13, 14. — *Texasia rivierae* (COLLIGNON, 1938).
PM K2b31, from the Lower Santonian *carezi* Subzone, La Jouane section.

Figures 1-6, 11-14 are × 1; fig. 7, 8 are × 2; fig. 9, 10 are × 4.

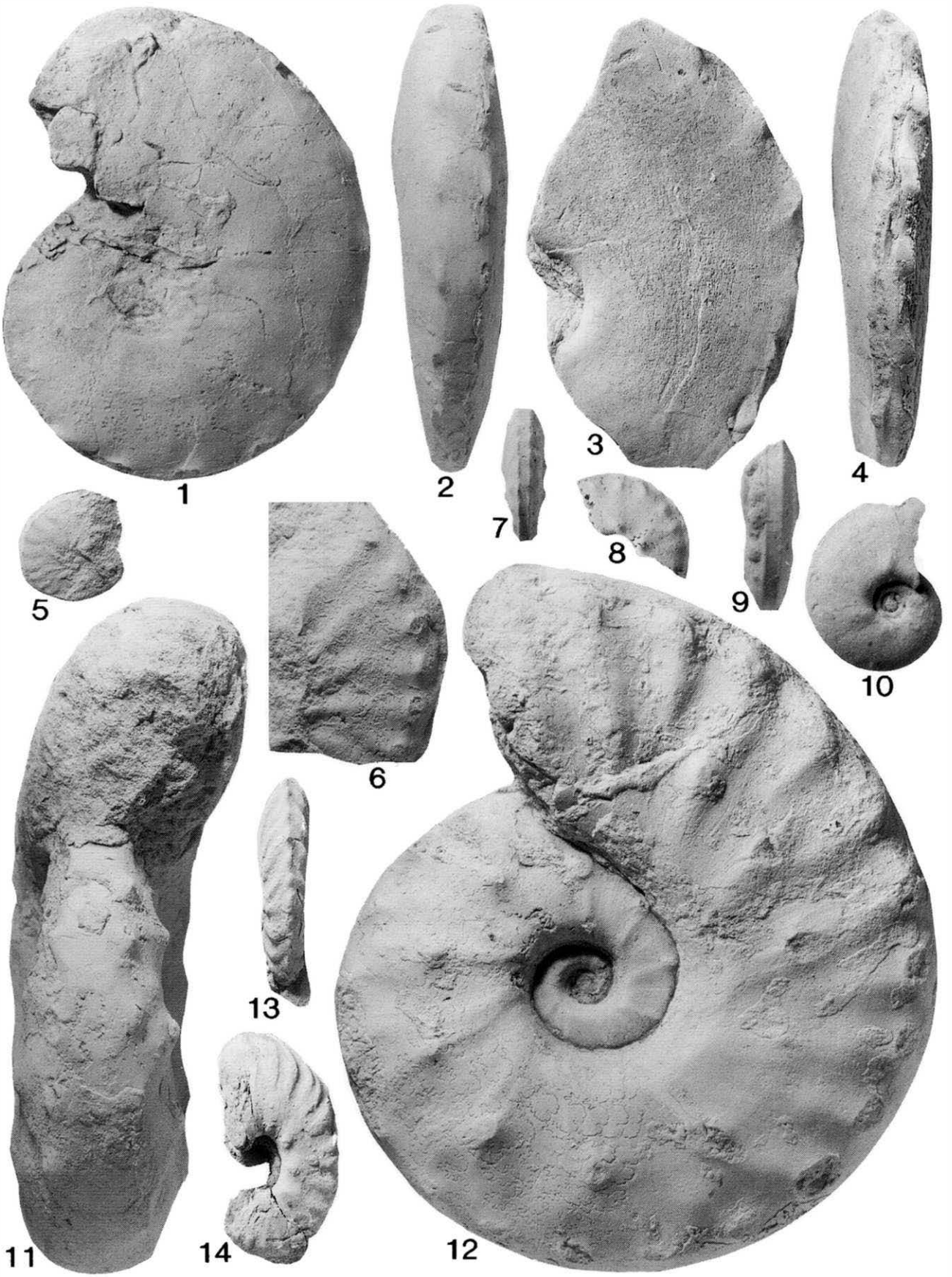
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PLATE 19

Fig. 1, 6. — *Pseudoschloenbachia (Pseudoschloenbachia) grossouvrei* sp. nov.
1, PM A8-31. 6, PM A8-30 all from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

2. — *Protexanites (Protexanites)* sp.
PM SO-2, from the Upper Coniacian *margae* or *serratomarginatus* Zones, environs of Soulatgé.

3, 4. — *Phlycticrioceras rude* sp. nov. Holotype.
PM E8-2, from the Upper Santonian *paraplanum* Subzone, Montagne de Brenz.

5. — *Protexanites (Protexanites) bourgeoisianus* (d'ORBIGNY, 1850).
SP unregistered, *ex* TOUCAS Collection, from the 'Coniacien supérieur à *Micraster brevis*, Ravin de Montferrand, Montagne des Cornes'.

7. — *Nowakites savini* (de GROSSOUVRE, 1894).
UPST M5, from the Middle Santonian of Sougraigne.

8, 9. — *Hoepenites* cf. *antecursator* (VAN HOEPEN, 1921).
SP unregistered, 'Sougraigne'.

10, 11. — *Gauthiericeras margae* (SCHLÜTER, 1867).
OUM KZ 17937. Upper Coniacian *margae* Zone, '300m NNW of Church, Sougraigne'.

All figures are × 1.

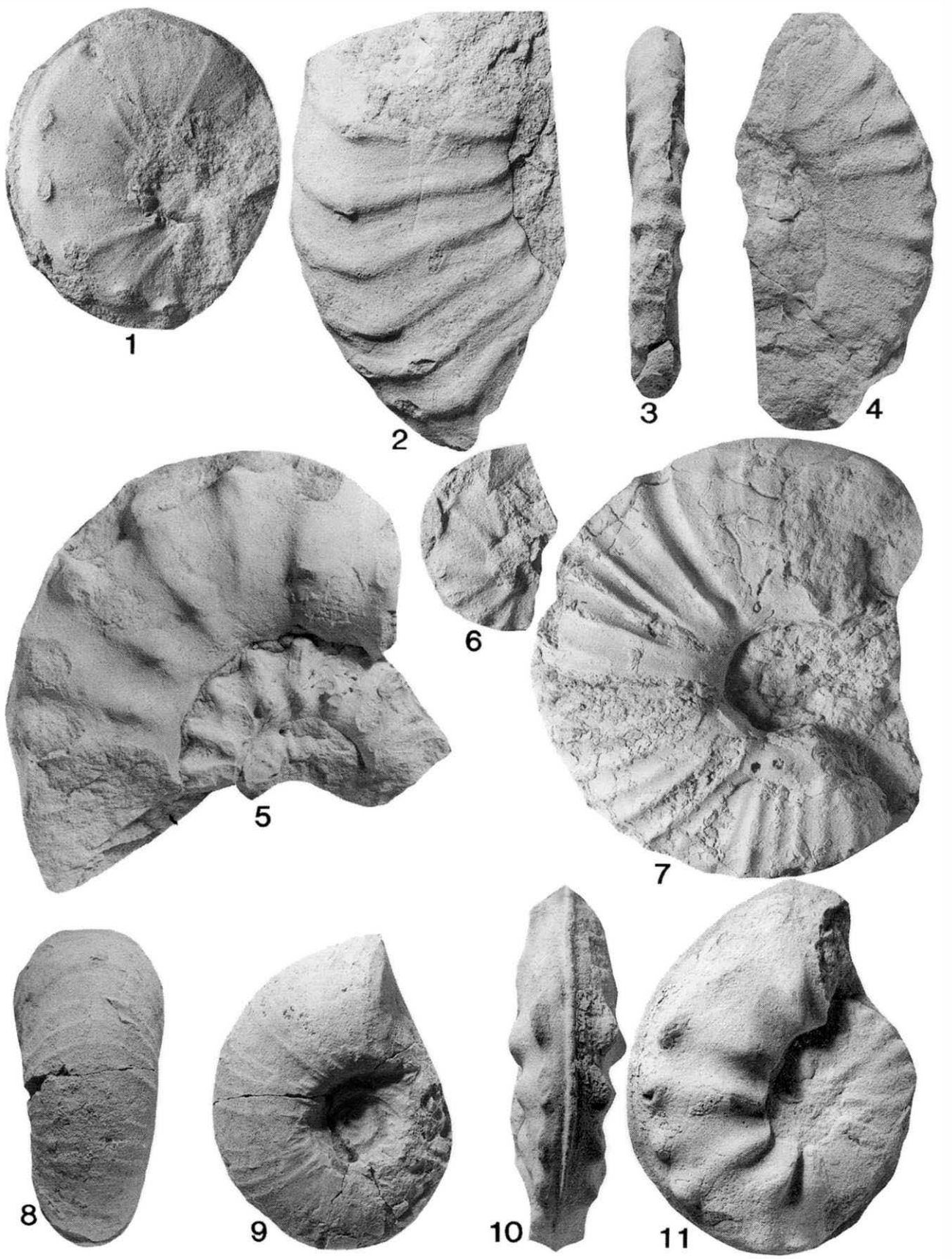
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PLATE 20

Fig. 1, 2. — *Peroniceras (Zuluiceras) isamberti* (FALLOT, 1885).
PM RO-11, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

3-5, 9, 11, 12. — *Peroniceras (Peroniceras) subtricarinatum* (d'ORBIGNY, 1850).
3-5, 9, MNHP d'ORBIGNY Collection nº 7183, from the environs of Sougraigne. 3-5, lectotype; 9, paralectotype. 11, SP unregistered, 'Coniacien supérieur à *Micraster brevis*, Ravin de Montferrand, Montagne des Cornes'. 12, PM ST11, from the Middle Coniacian *tridorsatum* Zone, east of Soulatgé.

6. — *Gauthiericeras nouelianum* (d'ORBIGNY, 1850).
PM LOb1, from the Middle Coniacian *tridorsatum* Zone, Les Tourtes.

7, 8. — *Peroniceras (Zuluiceras)* sp. juv. cf. *isamberti* (FALLOT, 1885).
UPST C3, from the Middle Coniacian *tridorsatum* Zone, east of La Montagne de Brenz.

10. — *Peroniceras (Zuluiceras)* sp.
SP unregistered, 'Coniacien supérieur à *Micraster brevis*, chemin de Bugarach à Linas'.

All figures are × 1.

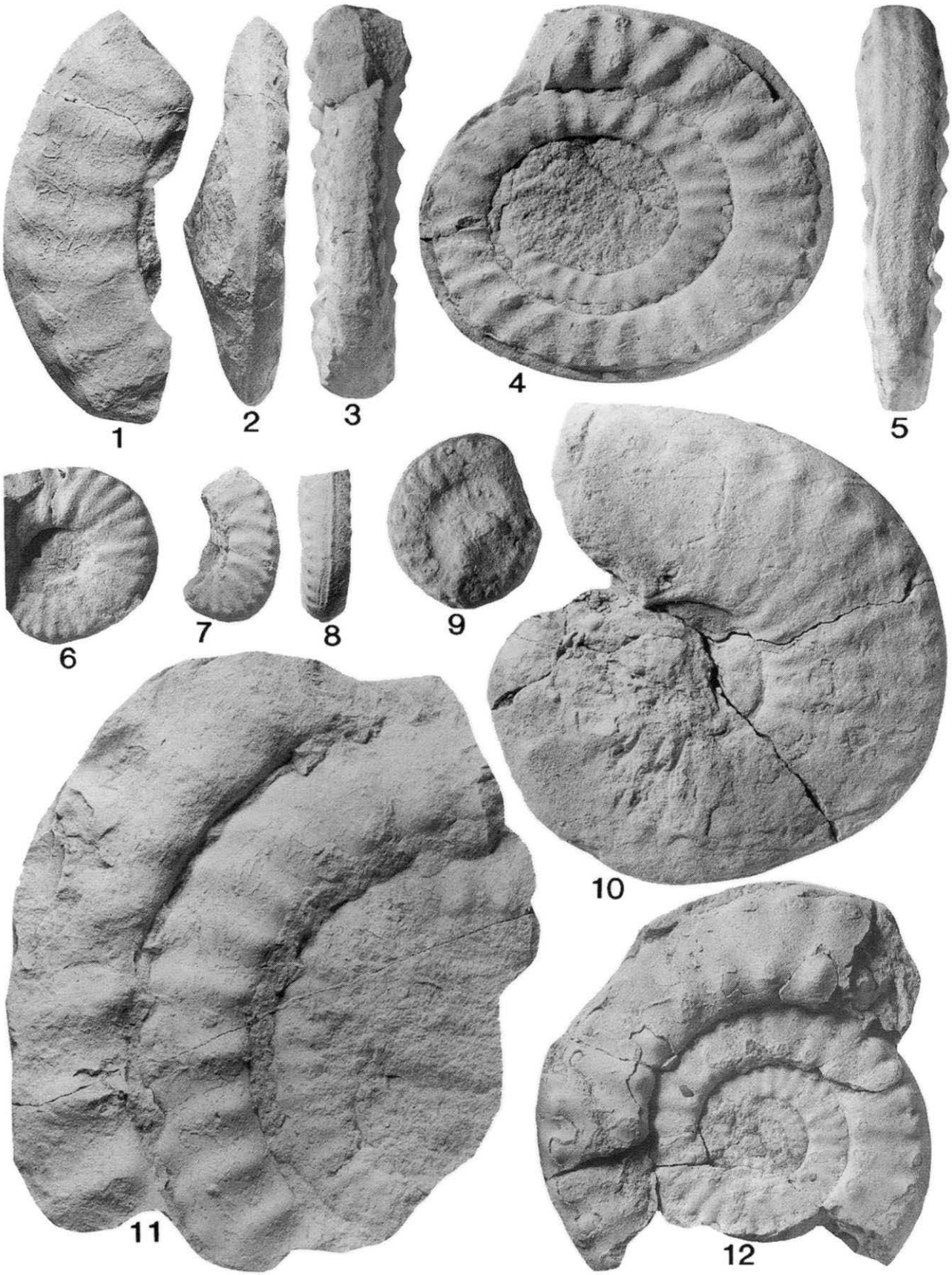
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PLATE 21

Fig. 1, 4, 5, 10, 11, 16. — *Protexanites (Protexanites) bontanti* (de GROSSOUVRE, 1894).
1, UPST 15, from the Upper Coniacian *serratomarginatus* Zone. 4, 5, PM K1b11, from the Upper Coniacian *serratomarginatus* Zone, La Jouane section. 10, 11, UM SEN-050, from 'La Forêt, ravin à l'est de Borde-Neuve'. 16, PM RE1-1, from the Upper Coniacian *serratomarginatus* Zone, Ravin de la Douce.

2, 3, 8. — *Gauthiericeras nouelianum* (d'ORBIGNY, 1850).
2, 3, PM LOb1. 8, PM LOb4, both from the Middle Coniacian *tridorsatum* Zone, Les Tourtes.

6, 7. — *Aneuretoceras variabile* (KENNEDY & COBBAN, 1991).
PM K0 1-19, from the Upper Coniacian *margae* Zone, La Jouane section.

9. — *Texanites (Texanites)* sp. juv. cf. *soutoni* (BAILY, 1885).
PM K3s12, from the Middle Santonian *gallicus* Subzone, La Jouane section.

12, 15. — *Protexanites (Protexanites) bourgeoisianus* (d'ORBIGNY, 1850).
12, PM K1b22. 15, PM K1b3, all from the Upper Coniacian *serratomarginatus* Zone, La Jouane section.

13. — *Peroniceras (Peroniceras) lepeei* (FALLOT, 1895).
UM SEN-049, 'vallon de la Forêt, E de Borde-Neuve', the original of BASSE, 1939 (p. 49) (as *Mortoniceras serratomarginatus* REDTENBACHER).

14. — *Paratexanites serratomarginatus* (REDTENBACHER, 1873).
UPST G01, from the Upper Coniacian *serratomarginatus* Zone, environs of Sougraigne.

All figures are × 1.

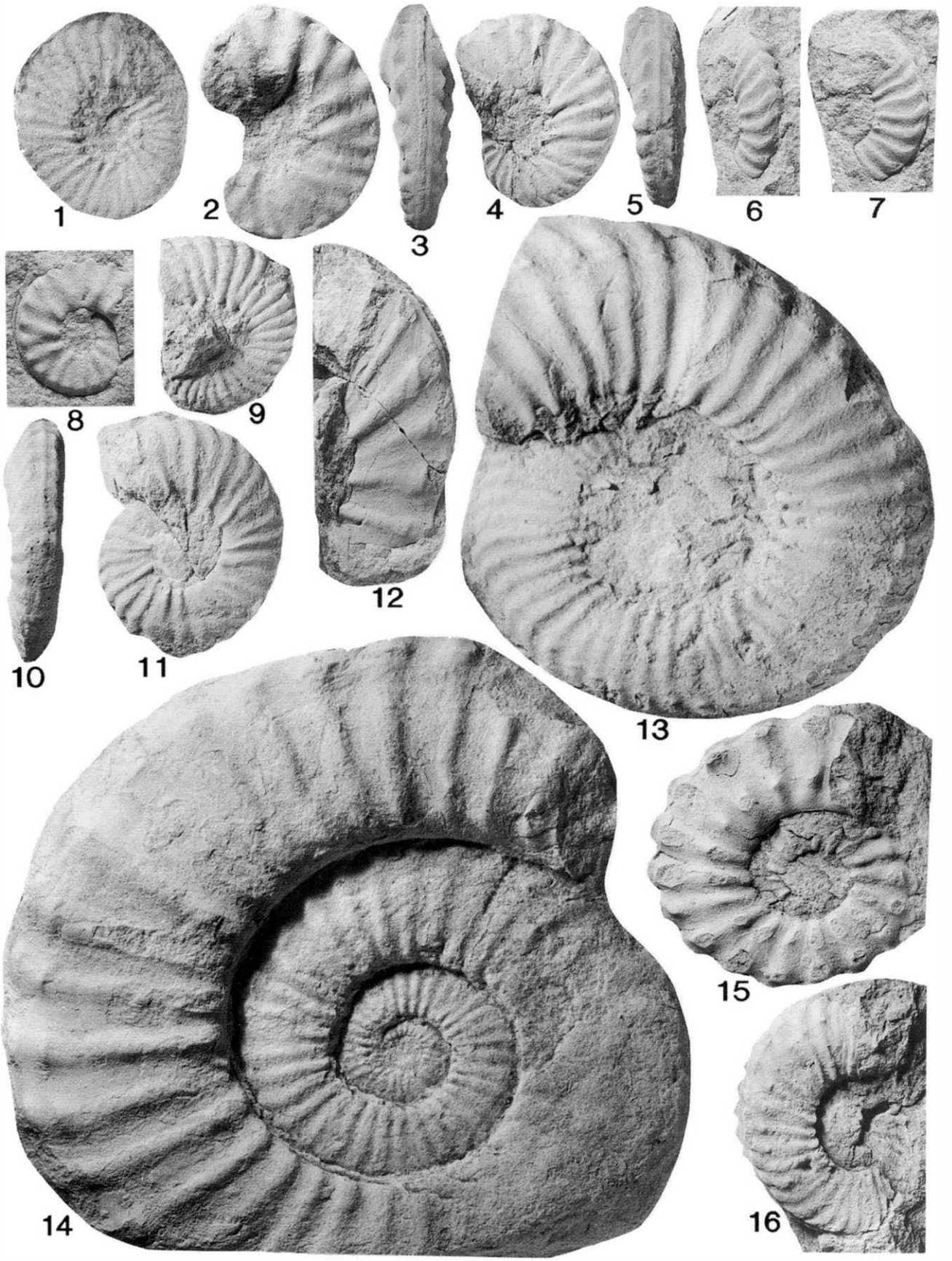
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PLATE 22

Fig. 1, 2, 4, 5. — *Nowakites savini* (de GROSSOUVRE, 1894).
1, 2, PM H5-14, from the Middle Santonian *gallicus* Subzone, East of La Montagne de Brenz. 4, 5, UPST MB07, the original of *Nowakites talavignesii* of COLLIGNON, 1983 (pl. 2, fig. 8) from the Middle Santonian *gallicus* Subzone, east of La Montagne de Brenz.

3. — *Mesopuzosia* sp. juv..
PM K1-11, from the Middle or Upper Coniacian, La Jouane section.

6. — *Pseudoschloenbachia (Pseudoschloenbachia)* gr. *umbulazi* (BAILY, 1855).
PM A8-29, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

7. — *Placenticeras maherndli* (SUMMESBERGER, 1979).
UPST L13, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

8, 10. — *Texanites (Texanites) quinquenodosus* (REDTENBACHER, 1873).
8, PM L3-3, from the Middle Santonian *gallicus* Subzone, Les Tourtes. 10, MNHP R52580, 'Santonien, Sougraigne'.

9. — *Pseudobarroisiceras rennense* (de GROSSOUVRE, 1894).
PM RO-29, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

11. — *Texanites (Texanites) gallicus* (COLLIGNON, 1948).
PM K3-2, from the Middle Santonian *gallicus* Subzone, La Jouane section.

12. — *Paratexanites zeilleri* (de GROSSOUVRE, 1894).
B1-1, from the Middle Coniacian *tridorsatum* Zone, Ravin de La Coume.

All figures are × 1.

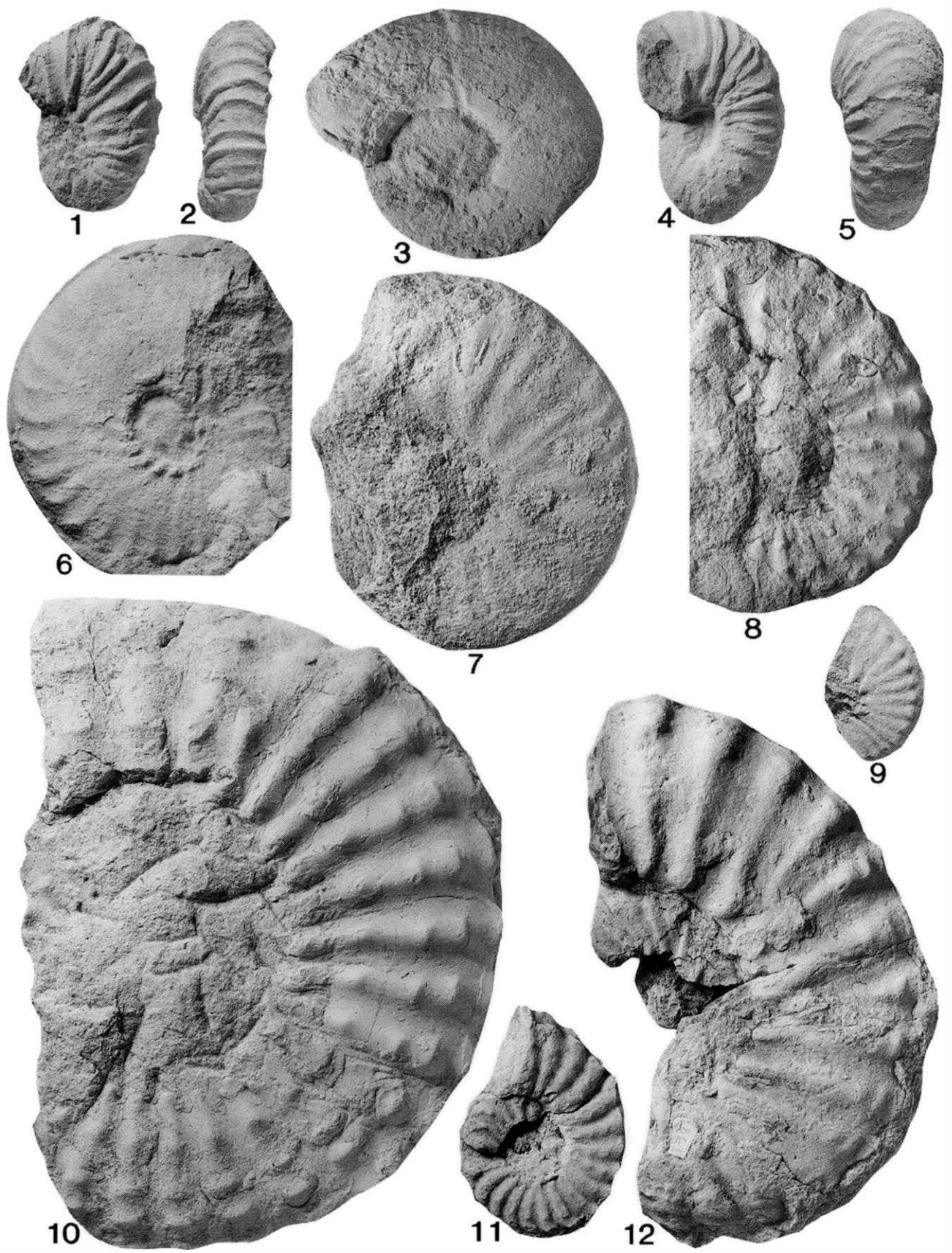
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PLATE 23

Fig. 1, 2. — *Paratexanites zeilleri* (de GROSSOUVRE, 1894).
PM RO-19, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis.

3-5. — *Texanites (Texanites) quinquenodosus* (REDTENBACHER, 1873).
3, PM G5b39; 4, 5, PM G5b7, all from the Middle Santonian *gallicus* Subzone, left bank of River Sals at Sougraigne.

6. — *Texanites (Texanites) americanus* (LASSWITZ, 1904).
PM G6-6, from the Upper Santonian *paraplanum* Subzone, left bank of River Sals at Sougraigne.

7. — *Texanites (Texanites) soutoni* (BAILY, 1855).
UPST S4, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

All figures are × 1.

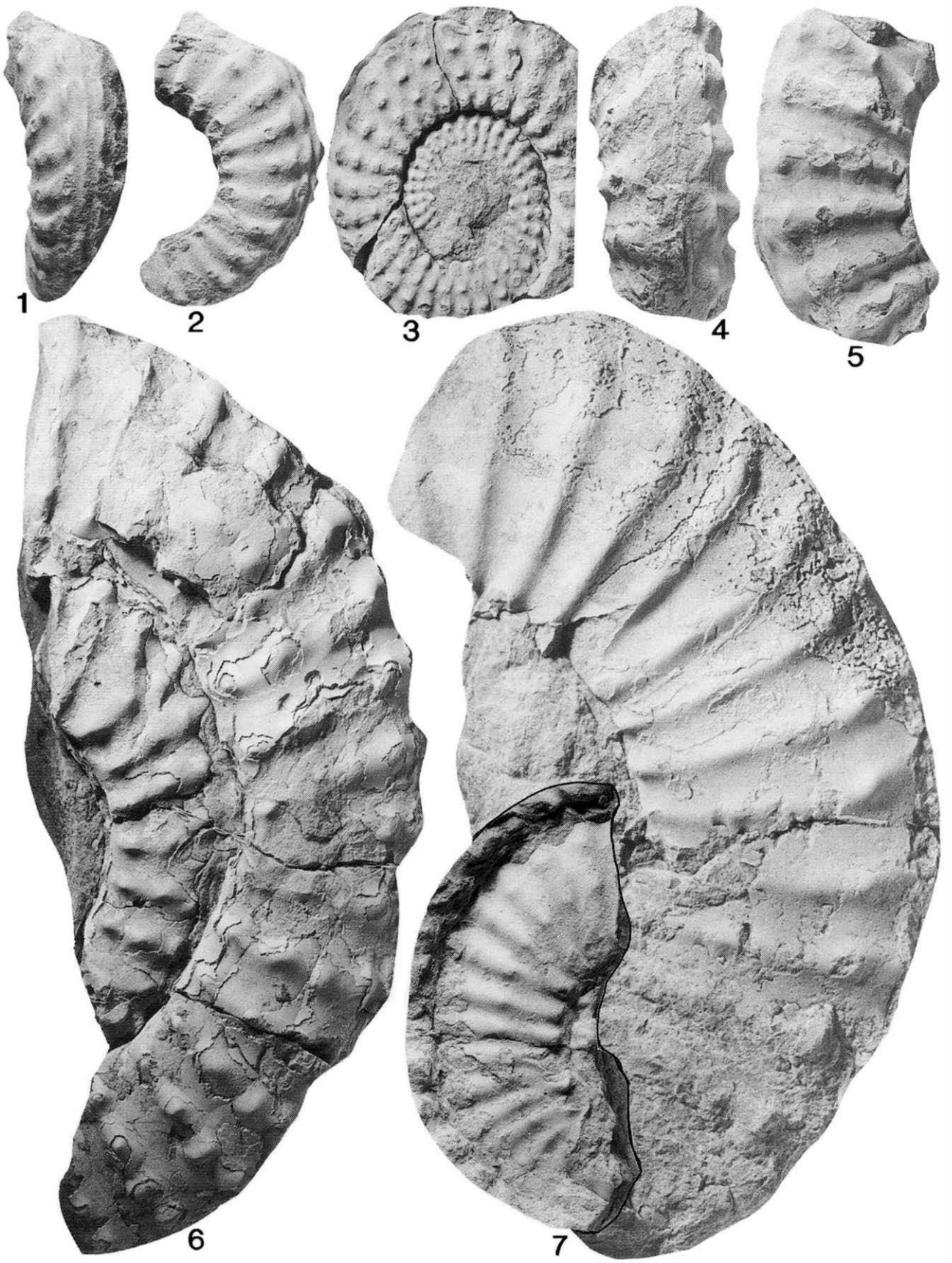
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PLATE 24

Fig. 1. — *Metatissotia* sp. 1 UM SEN-027, the original of *Tissotia redtenbacheri* de GROSSOUVRE of SÉNESSE, 1937 (p. 35, pl. 11, fig. 4) from the Middle Coniacian *tridorsatum* Zone of Soulatgé.

2. — *Metatissotia* sp.
2. UM SEN-029, the original of *Tissotia robini* THIOLLIÈRE of SÉNESSE, 1937 (p. 35, pl. 11, fig. 3) from the Middle Coniacian *tridorsatum* Zone of Soulatgé.

3, 4. — *Tissotioides haplophyllus* (REDTENBACHER, 1873).
3, PM RO-4, from the Middle Coniacian *tridorsatum* Zone, Les Pastressis. 4, PM SO-3, from the Middle Coniacian *tridorsatum* Zone, west of Soulatgé.

5. — *Metatissotia ewaldi* (VON BUCH, 1848).
PM ST XIV, from the Middle Coniacian *tridorsatum* Zone, east of Soulatgé.

All figures are × 1.

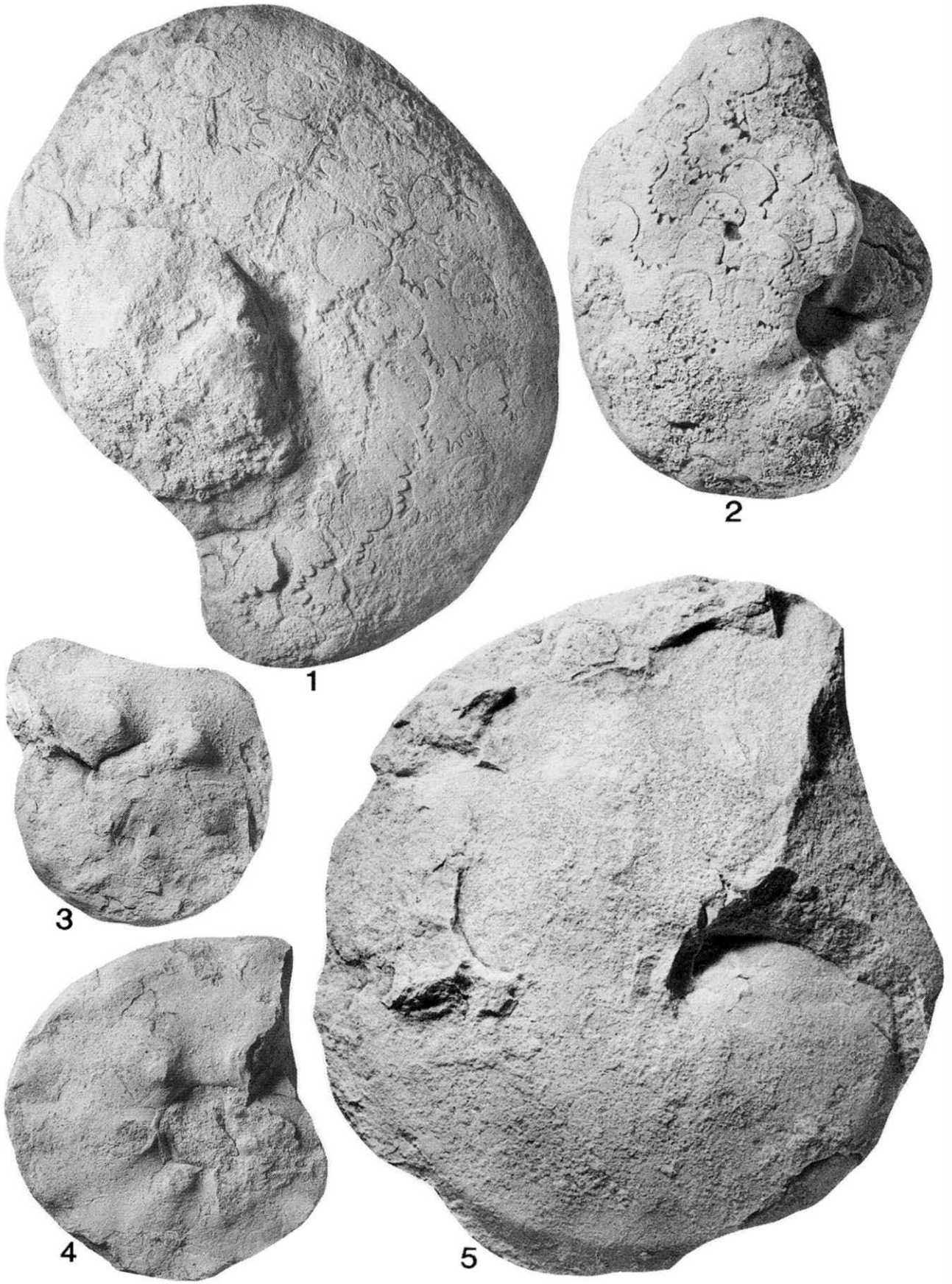
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PLATE 25

Fig. 1, 2, 6, 7. — *Eulophoceras* spp. juv.
1, 2, UPST MB41, the holotype of *Eulophoceras grossouvrei* COLLIGNON, 1983 (pl. 7, fig. 5) from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. 6, 7, UPST S8, the original of *Eulophoceras* cf. *miloni* HOURCQ of COLLIGNON, 1983 (pl. 7, fig. 4) from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

3-5. — *Eulophoceras austriacum* (SUMMESBERGER, 1979).
3, 4, OUM KZ 20694, from the Upper Santonian *paraplanum* Subzone of La Jouane. 5, UPST unregistered, from the Upper Santonian *paraplanum* Subzone of La Jouane.

8-10. — *Paralenticeras caneroti* COLLIGNON, 1983.
Holotype, UPST MB20, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

11. — *Metatissotia nodosa* HYATT, 1903.
PM BOa3, from the Middle Coniacian *tridorsatum* Zone, Ravin de La Coume.

12-16. — *Tissotia ewaldi* (VON BUCH, 1848).
12, 13, SP unregistered, *ex* TOUCAS Collection. Original of de GROSSOUVRE, 1894 (pl. 9, fig. 5) from the 'Calcaires à *Cyphosoma Archiaci*, de la base de l'étage sénonien. Environ de Rennes-les-Bains'. 14, 15, UM SEN-025, Middle Coniacian *tridorsatum* Zone, 'région de Bugarach, Soulatgé (Al Bouich), au nord de la route'. 16, UM SEN-028, from the same horizon and locality as the original of 14, 15.

Figures 1, 2, 6-16 are × 1; fig. 3-5 are × 2.

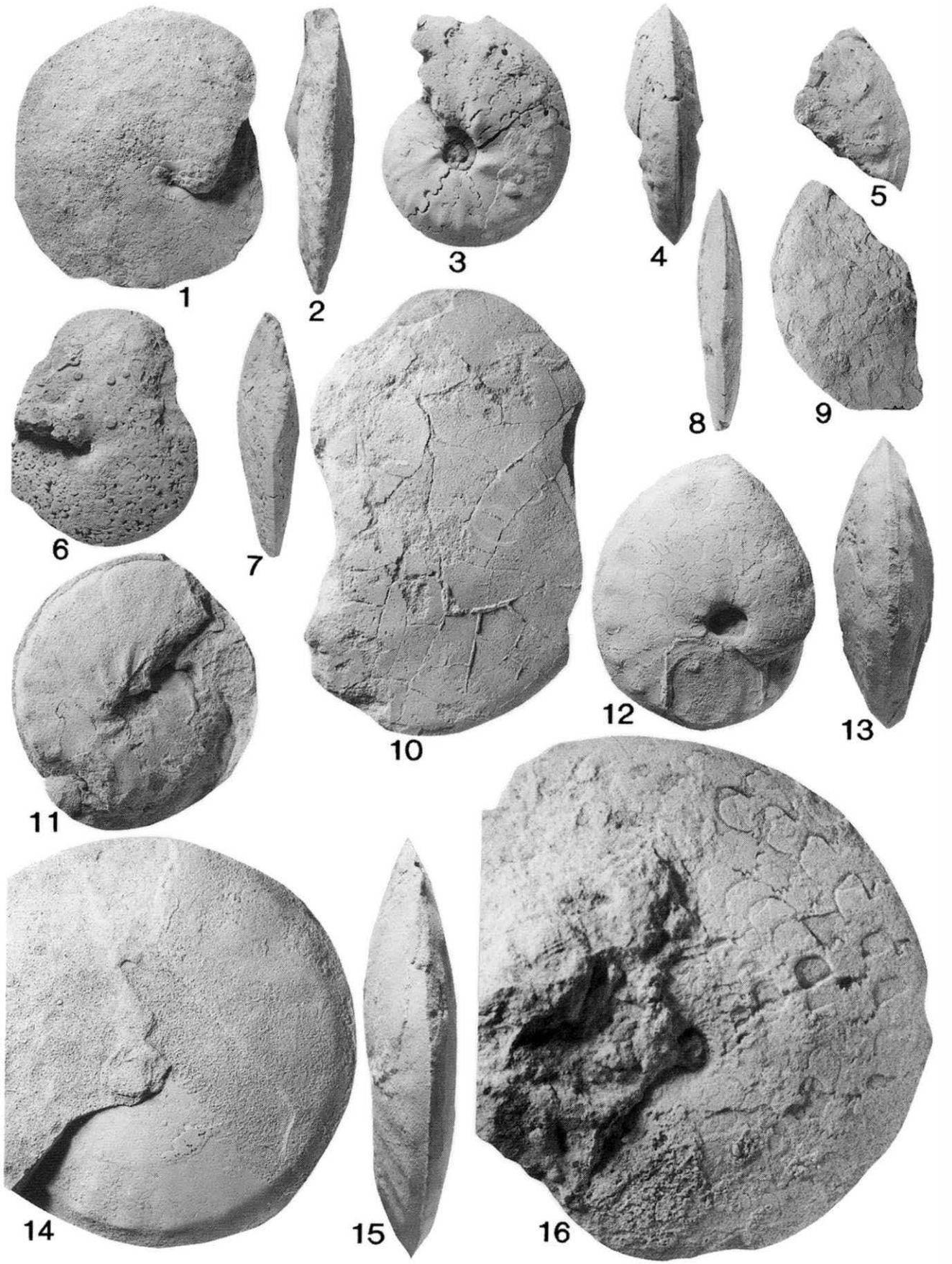
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PLATE 26

Fig. 1, 2. — *Metatissotia* cf. *redtenbacheri* de GROSSOUVRE, 1894.
PM B1 ? 1, from the Middle Coniacian *tridorsatum* Zone, Ravin de La Coume.

3, 4, 7. — *Eulophoceras natalense* HYATT, 1903.
3, 4, SP unregistered *ex* TOUCAS Collection, 'Santonien inférieur, Ravin de Montferrand, Montagne des Cornes'.
7, UPST L14, from the 'marnes à *Micraster*, chemin de Montferrand'.

5, 6. — *Metatissotia ewaldi* (VON BUCH, 1848).
PM NO-7, from the Middle Coniacian *tridorsatum* Zone, Les Bringots.

8. — *Eulophoceras austriacum* (SUMMESBERGER, 1979).
PM A9-3, from the Upper Santonian *paraplanum* Zone, chemin de Sougraigne aux Croutets.

All figures are x 1.

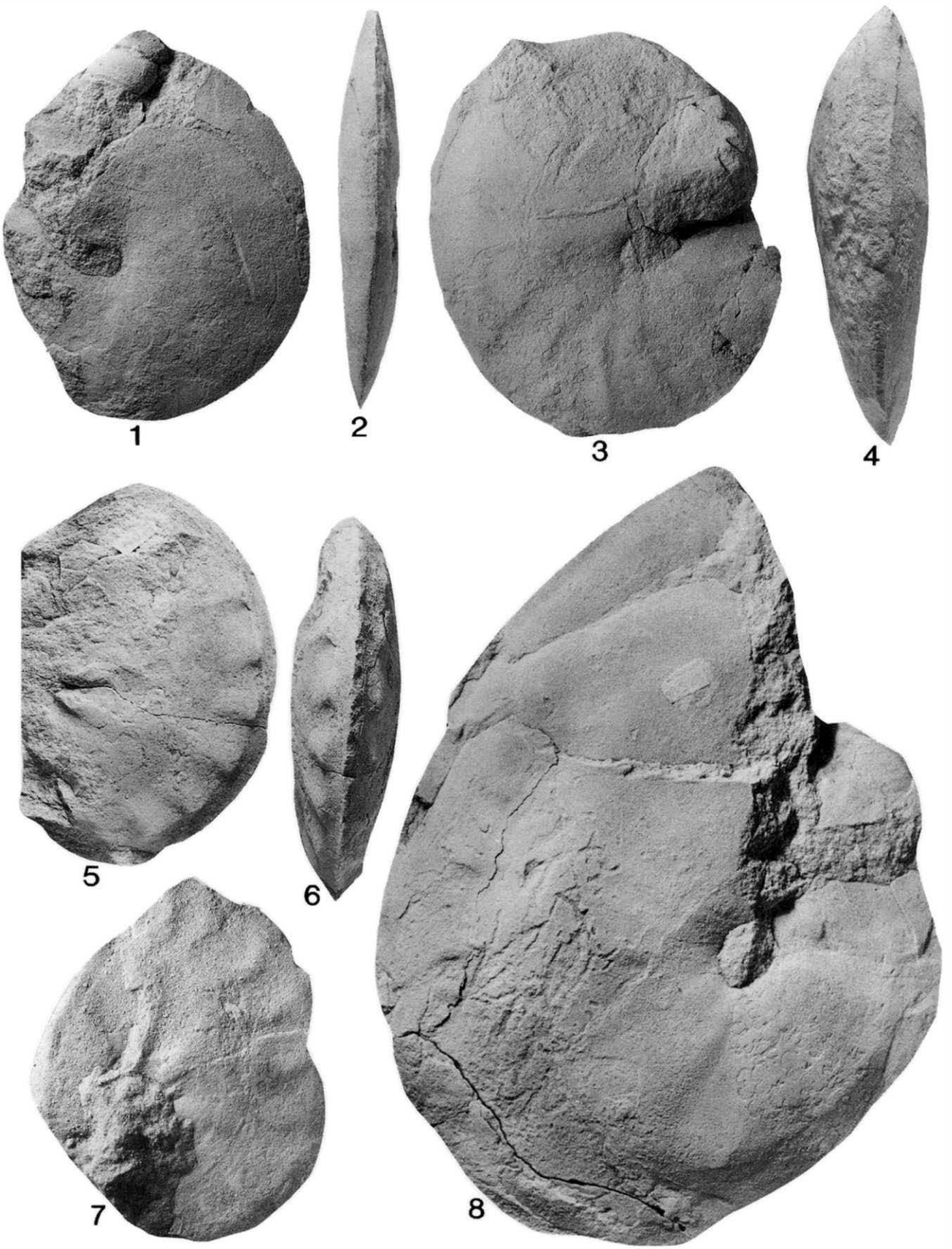
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PLATE 27

Fig. 1-9. — *Baculites* sp.
1-3, UPST L5, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. 4, 5, PM K3s11, from the Middle Santonian *gallicus* Subzone, La Jouane section. 6-9, UPST L2, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

10, 11, 12, 20, 21, 23. — *Tridenticeras varians* (SCHLÜTER, 1876).
10, PM K01-13; 11, PM K01-15; 12, PM K01-16, all from the Middle Coniacian *tridorsatum* Zone, La Jouane section. 20, PM P1-21; 21, PM P1-22, from the Upper Coniacian *margae* Zone, west of the Col du Linas. 23, PM L0b 2, from the Middle Coniacian *tridorsatum* Zone, Les Tourtes.

13-15, 17. — *Neocrioceras (Schlueterella) compressum* KLINGER, 1976.
13, 14, PM L3-4; 15, PM L3-1, both from the Middle Santonian *gallicus* Subzone, Les Tourtes. 17, PM K4b5, from the Middle Santonian *gallicus* Subzone, La Jouane section.

16, 24. — *Glyptoxoceras crispatum* (MOBERG, 1885).
16, PM K2b21, from the Lower Santonian *carezi* Subzone, La Jouane section. 24, PM G5b38, from the Middle Santonian *gallicus* Subzone, left bank of River Sals.

18, 19. — *Allocrioceras* aff. *burckhardti* KENNEDY & COBBAN, 1991.
B5-39, from the Middle Santonian *gallicus* Subzone, Ravin de La Coume.

22. — *Hyphantoceras* aff. *plicatum* (d'ORBIGNY, 1842).
PM K4a2, from the Middle Santonian *gallicus* Subzone, La Jouane section.

Figures 1-21, 23, 24 are × 1; fig. 22 is × 2.

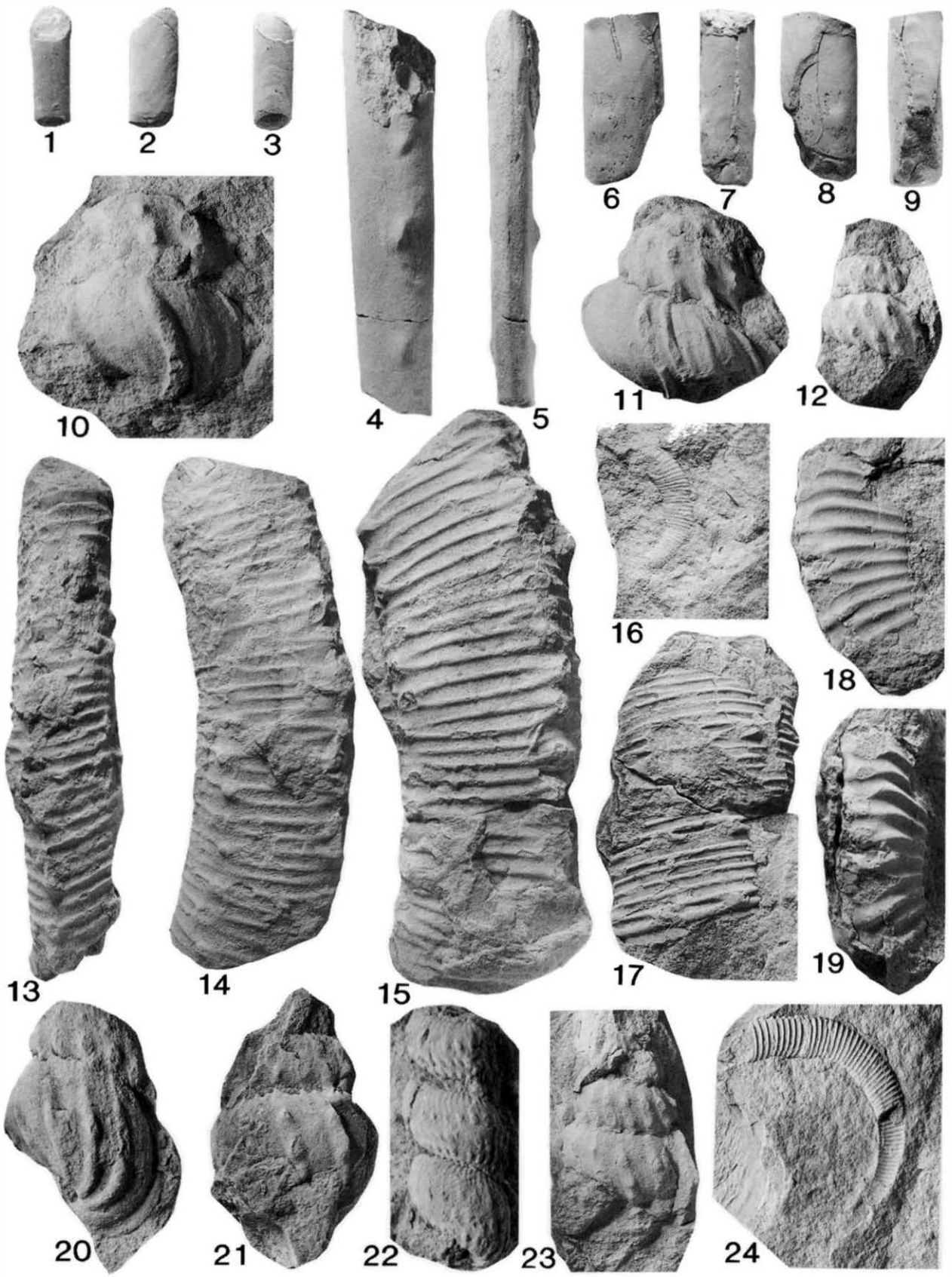
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PLATE 28

Fig. 1-8, 10-19. — *Jouaniceras sicardi* (de Grossouvre, 1894).
1, MNHP R1194, the original of de Grossouvre, 1894 (pl. 37, fig. 6) from the 'Marnes ferrugineuses à *Placenticeras syrtale*, comprises entre les deux bancs inférieurs de rudistes du chemin de Sougraigne aux Croutets'; 2, OUM KZ 17985; 3, OUM KZ 17944; 4, OUM KZ 17972; 5, OUM KZ 17961; 6, OUM KZ 17974; 7, OUM KZ 17985; 8, OUM KZ 20697. 10, OUM KZ 20696; 11, OUM KZ 20699; 12, OUM KZ 20700, 13. UM SEN-036a, the original of Basse, 1939 (pl. 3, fig. 4). 16-19, UM SEN-036b, the original of Basse, 1939 (pl. 3, fig. 7). All are from the Upper Santonian *paraplanum* Subzone of La Jouane.

9, 31, 32. — *Eubostrychoceras acuticostatum* (d'Orbigny, 1842).
9, holotype, MNHP d'Orbigny Collection 7210, the original of d'Orbigny, 1842 (pl. 147, fig. 3, 4) from the 'environs de Soulatgé'. 31, 32, PMG5c4, from the Middle Santonian *gallicus* Subzone, left bank of River Sals at Sougraigne.

20-23. — *Hyphantoceras plicatum* (d'Orbigny, 1842).
20, 23, originals of Schlüter, 1872 (pl. 36, fig. 6, 7) Geological and Palaeontological Institute, Bonn University type collections nº 77a-b, from the 'Emscher-Mergel der Zeche Hansemann bei Mengede, unweit Dormund in Westfälen'. 21, 22, holotype, MNHP R1196, d'Orbigny Collection, nº 7211, the original of d'Orbigny, 1842 (pl. 143, fig. 7, 8) from the 'environs de Soulatgé'.

24-30. — *Hyphantoceras* ? *amapodense* (Van Hoepen, 1921).
24, 25, MNHP B 174609, from the environs of Rennes-les-Bains. 26, 28, PM A7-3, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets. 27, UPST L9, from the Middle Santonian *gallicus* Subzone, east of Sougraigne. 29, 30, MNHP B17460e, from the environs of Rennes-les-Bains.

33. — *Neocrioceras (Neocrioceras)* sp.
PM K4b2, from the Middle Santonian *gallicus* Subzone, La Jouane section.

Figures 1, 9, 20, 21, 23-26, 28-32 are × 1; fig. 2, 3, are × 4; fig. 5-8, 10-19, 22, 27, are × 2.

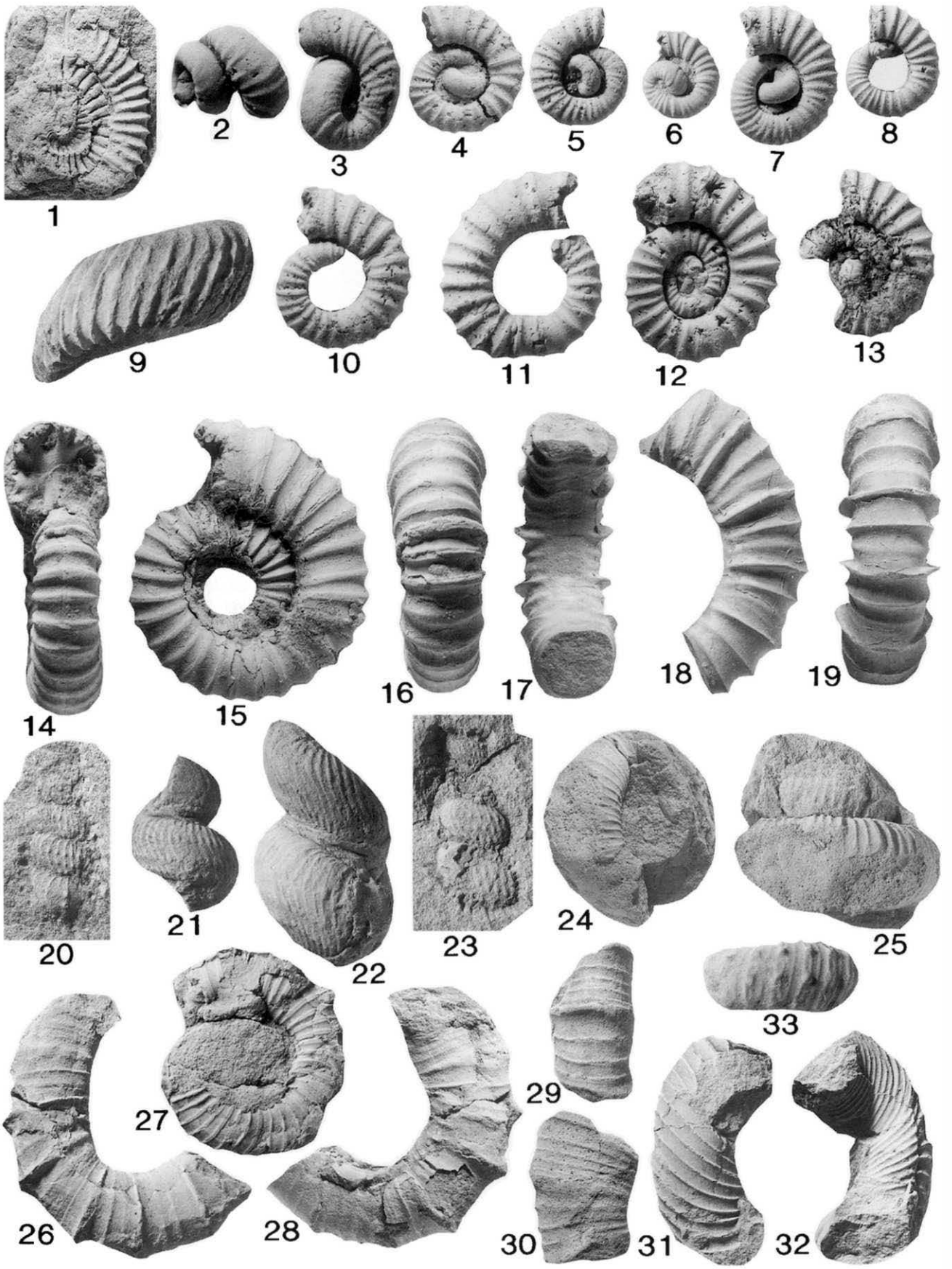
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PLATE 29

Fig. 1, 8, 10, 11, 19, 20. — *Glyptoxoceras crispatum* (MOBERG, 1885).
1, 8, UPST from Sougraigne; 10, PM G6-8; 11, PM G6-13; 19, PM G6-5; 20, PM G6-4, all from the Upper Santonian *paraplanum* Subzone, left bank of River Sals at Sougraigne.

2, 3. — *Pseudoxybeloceras* (*Parasolenoceras*) aff. *splendens* COLLIGNON, 1969.
UPST S 13, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

4-7. — *Neocrioceras (Schlueterella) compressum* KLINGER, 1976.
4, 5, PM K4b4, from the Middle Santonian *gallicus* Subzone, La Jouane section. 6, 7, PM G4b1, from the Middle Santonian *gallicus* Subzone, left bank of River Sals at Sougraigne.

9. — *Pseudoxybeloceras (Pseudoxybeloceras)* sp.
PM Ka 1-20 from the Middle Coniacian *tridorsatum* Zone, La Jouane section.

12, 13, 16, 17. — *Glyptoxoceras* sp.
SP unregistered *ex* TOUCAS Collection. 12, 13, 'Ravin de Montferrand, Montagne des Cornes'. 16, 17, 'Sougraigne'.

14, 15, 18. — *Glyptoxoceras souqueti* COLLIGNON, 1983.
14, 15, holotype, UPST MB24, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets (Grès des Croutets). 18, UPST 25, from the Upper Santonian *paraplanum* Subzone, Sougraigne.

All figures are **x 1**.

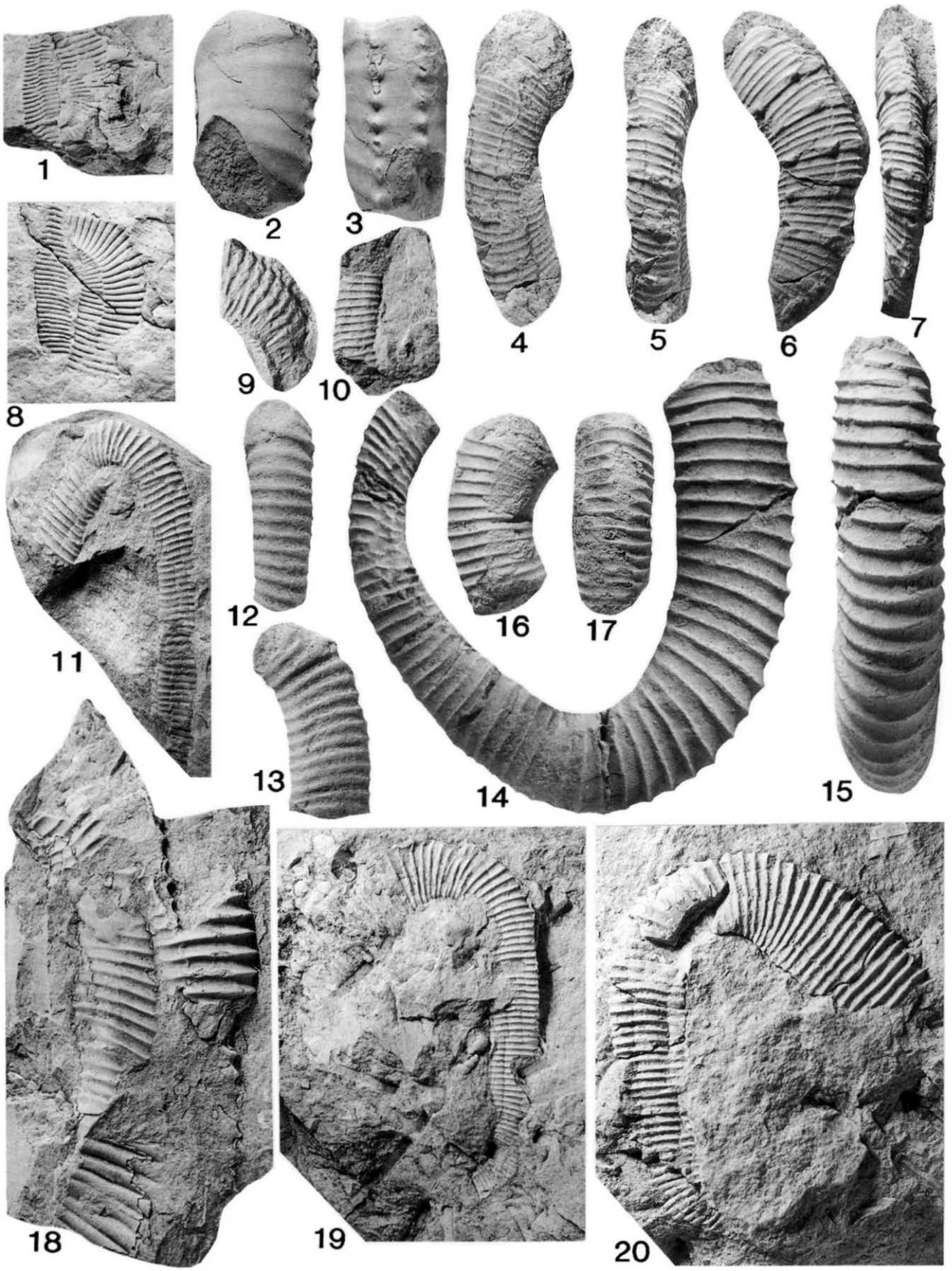
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PLATE 30

Fig. 1, 18, 19. — *Yezoites* sp.
1, UM SEN-047; 18, 19, H. Godet Collection (Grenoble), both from the Upper Santonian *paraplanum* Subzone of La Jouane.

2-17, 20, 21, 26, 27, 43. — *Scaphites (Scaphites) leei* Reeside, 1927, Form II of Cobban, 1969.
2, 3, UPST 29a; 4, 5, UPST 29b; 6, UPST 29c; 7, 8, UM SEN-046a, syntype of *S. senessei* Basse, 1939. 9-11, UM SEN-046b, syntype of *S. senessei* Basse, 1939. 12, 13, UM SEN-047b. 14, 15, OUM KZ 20689; 16, 17, UM SEN-047c; 20, 21, OUM KZ 20698; 26, 27, UPST MB29; 43, UM SEN-047d. Unless otherwise stated all specimens are from the Upper Santonian *paraplanum* Subzone of la Jouane.

22, 32, 35, 36. — *Yezoites orbignyi* nom. nov.
22, holotype, the original of *Scaphites compressus* d'Orbigny, 1842 (pl. 128, fig. 4, 5) MNHP d'Orbigny Collection nº 7139, from the 'environs of Soulatgé'. 32, 36, PM RO-14, from the Upper Coniacian *margae* Zone, Les Pastressis. 35, PM K1c17, from the Lower Santonian *carezi* Subzone, La Jouane section.

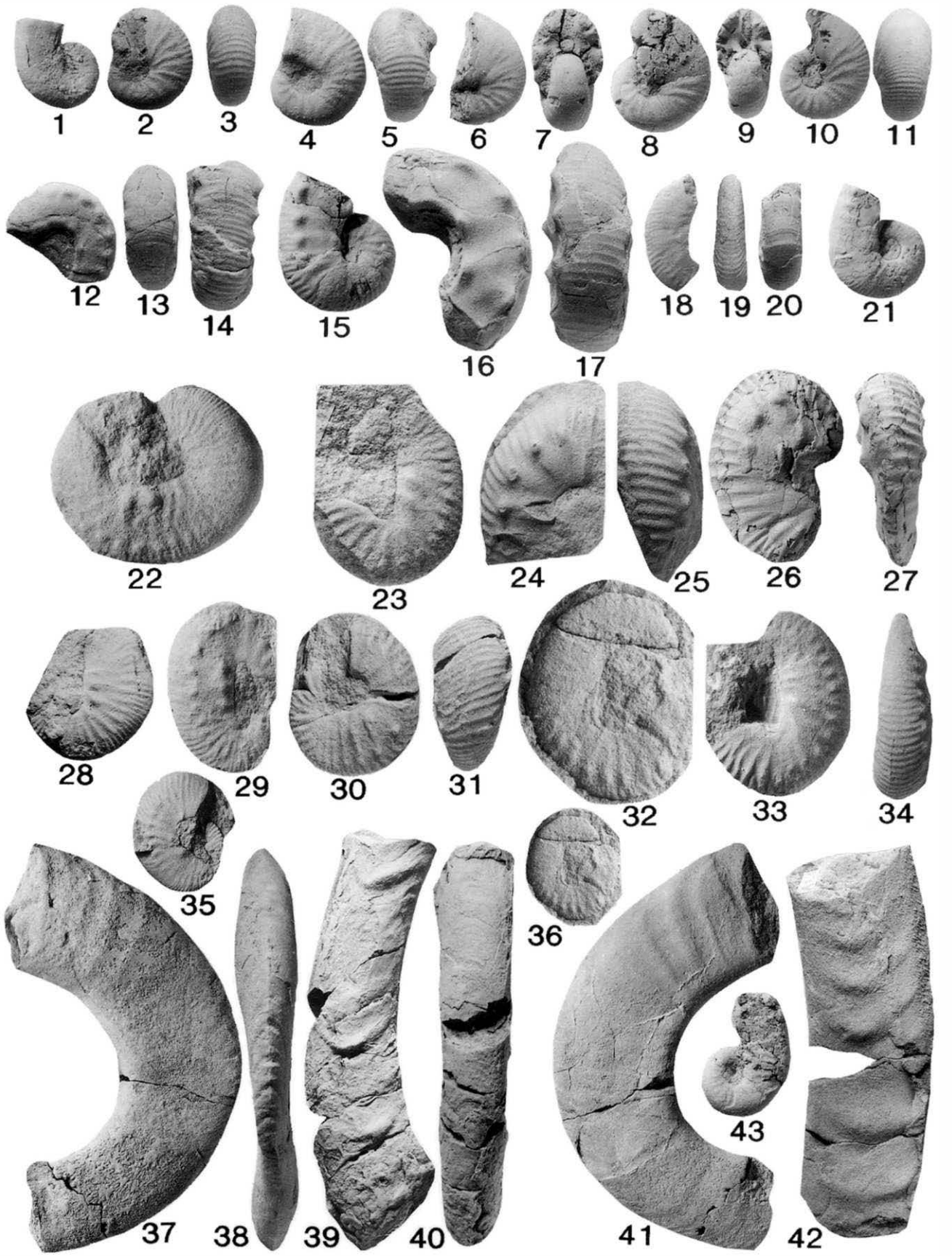
23, 24, 25, 29-31, 33, 34. — *Scaphites (Scaphites) kieslingswaldensis kieslingswaldensis* Langenhan & Grundey, 1891.
23, PM RO-22, from the Upper Coniacian *serratomarginatus* Zone, Les Pastressis. 24, 25, UM SEN-056, north of La Bastide de Camps between the ruisseau des Pastressis and le Causse de la Bastide. 29, PN P1-11; 30, 31, PM P1-10, from the Upper Coniacian *margae* Zone, from the west of Le Col du Linas. 33, 34, UPST S12, from the Marnes à *Micraster*, Soulatgé.

28. — *Scaphites (Scaphites)* or *Yezoites* sp.
UPST unregistered, Marnes à micrasters, chemin de Montferrand.

37, 38, 41, 42. — *Boehmoceras krekeleri* (Wegner, 1905).
37, 38, 41, UPST L1, from the Upper Santonian *paraplanum* Subzone, environs of Sougraigne. 42, PM A7-1, from the Upper Santonian *paraplanum* Subzone, chemin de Sougraigne aux Croutets.

39, 40. — *Boehmoceras arculus* (Morton, 1834).
PM G5b14, from the Middle Santonian *gallicus* Subzone, left bank of River Sals at Sougraigne.

Figures 1-17, 21, 32, 43 are × 2; fig. 18, 19, 22-31, 33-42 are × 1.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