

# The high Cretaceous ammonite fauna from Tercis, Landes, France

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## Abstract

The very high Cretaceous ammonite fauna from the area close to Tercis-les-Bains, south-west of Dax, Landes, France, has been revised. Even the lower (but not lowest) part of the Grande Carrière is already near the top of the Campanian, belonging to the Zone of *Nostoceras hyatti*. This assemblage-zone has yielded *Hauericeras fayoli* (DE GROSSOUVRE, 1894), *Pseudokossmaticeras brandti* (REDTENBACHER, 1873), *P. tercense* (SEUNES, 1892), *Pachydiscus (Pachydiscus) perfidus* (DE GROSSOUVRE, 1894), *P. (P.) subrobustus* (SEUNES, 1892), *P. (P.) cf. colligatus* (BINKHORST, 1861), *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941, *N. (N.) helicinum* (SHUMARD, 1861) and *Baculites leopoliensis* NOWAK, 1908. This assemblage is comparable to that found in the Zone of *Pseudokossmaticeras tercense* in the region of the Bay of Biscay, and to that found in the Zone of *Nostoceras pozaryskii* (here re-named the Zone of *Nostoceras hyatti*) of the Vistula Valley in Poland.

The lowest occurrence of the overlying Zone of *Pachydiscus epiplectus*, and the lowest Maastrichtian recognisable in ammonite terms, is marked by the incoming of *Hoploscaphites constrictus* (J. SOWERBY, 1817). Other ammonite species from this zone are: *Pachydiscus (Pachydiscus) epiplectus* (REDTENBACHER, 1873) and *Pachydiscus (P.) neubergicus* (VON HAUER, 1858).

A higher ammonite Zone of *Menuites [Anapachydiscus] fresvillensis* has been detected only from museum specimens from La Pointe to the north of the Grande Carrière. The ammonites known from this zone are: *Pachydiscus jacquoti jacquoti* (SEUNES, 1890a), *Pachydiscus (Pachydiscus) armenicus* ATABEKIAN & AKOPIAN, 1969, *Desmophyllites larteti* (SEUNES, 1892), *Diplomoceras cylindraceum* (DEFRANCE, 1816), *Glyptoxoceras rugatum* (FORBES, 1846).

The highest Maastrichtian ammonite zone in the Biscay region is that of *Menuites [Anapachydiscus] terminus*. This has not been detected near Tercis.

**Key-words:** Campanian, Maastrichtian, ammonites, zones, south-west France.

## Résumé

La faune d'ammonites de la fin du Crétacé récoltée dans la région de Tercis, au sud-ouest de Dax (Landes, France) est révisée.

La partie inférieure (mais non les couches de base) de la Grande Carrière appartient déjà à la Zone à *Nostoceras hyatti*, ce qui indique un âge proche de la fin du Campanien. Cette zone d'assemblage réunit les espèces *Hauericeras fayoli* (DE GROSSOUVRE, 1894), *Pseudokossmaticeras brandti* (REDTENBACHER, 1873), *P. tercense* (SEUNES, 1892), *P. (P.) cf. colligatus* (BINKHORST, 1861), *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941, *N. (N.) helicinum* (SHUMARD, 1861) et *Baculites leopoliensis* NOWAK, 1908. Cet assemblage est comparable à celui de la Zone à *Pseudokossmaticeras tercense* dans la région du

Golfe de Gascogne et à celui de la Zone à *Nostoceras pozaryskii* (dénommée ici de la Zone à *Nostoceras hyatti*) dans la vallée de la Vistule, en Pologne.

La base de la Zone à *Pachydiscus epiplectus* sus-jacente et celle de l'étage Maastrichtien sont caractérisées par l'apparition d'*Hoploscaphites constrictus* (J. SOWERBY, 1817). D'autres espèces d'ammonites rencontrées dans cette zone sont: *Pachydiscus (Pachydiscus) epiplectus* (REDTENBACHER, 1873) et *Pachydiscus (P.) neubergicus* (VON HAUER, 1858).

La Zone à *Anapachydiscus fresvillensis*, une zone d'ammonites plus élevée, n'a été identifiée que sur base de spécimens de collections provenant de La Pointe, au nord de la Grande Carrière. Les ammonites présentes dans cette zone sont: *Pachydiscus jacquoti jacquoti* (SEUNES, 1890a), *Pachydiscus (Pachydiscus) armenicus* ATABEKIAN & AKOPIAN, 1969, *Desmophyllites larteti* (SEUNES, 1892), *Diplomoceras cylindraceum* (DEFRANCE, 1816) *Glyptoxoceras rugatum* (FORBES, 1846).

La zone d'ammonites la plus élevée du Maastrichtien dans la région de la Biscaye est celle à *Anapachydiscus terminus*. Elle n'a pas été observée aux environs de Tercis.

**Mots-clefs:** Campanien, Maastrichtien, ammonites, zones, sud-ouest de la France.

## Introduction

For ammonite stratigraphy the importance of Tercis is that it provides an expanded section spanning the Campanian-Maastrichtian boundary. This is particularly true if one adopts - as we do - the boreal belemnite standard for the stage boundary, but it possibly also applies if one uses the tethyan planktic foraminiferal standard.

It was only recently that the ammonite succession in the high Upper Campanian to lowest Maastrichtian has been knowingly studied. Many authors have regarded the Zone of *Bostrychoceras polyplacum* to be the marker for the top of the Campanian, e.g. DALBIEZ, 1960; RAWSON *et al.*, 1978. It was the work of BLASZKIEWICZ (1980) in Poland showed that there were further distinct ammonite zones above this within the Campanian: his Zones of *Didymoceras donezianum* and *Nostoceras pozaryskii* corresponded to a belemnite Zone of *Belemnitella langei*. This top part of the Campanian is still ignored by many writers; for example, it is simply missing, leaving a stratigraphical gap, in the EXXON

chart (HAQ *et al.*, 1987, 1988). This top part of the Campanian at Tercis is not only expanded but provides most of the fossils. Thus, though one would always like more specimens, there are sufficient available from known beds to recognise a reliable stratigraphy.

#### Previous ammonite zonations for the high Campanian to Maastrichtian

Uppermost Campanian and Maastrichtian ammonite zonation for western European successions has been less refined, and less satisfactory, than that based on other groups. DE GROSSOUVRE (1901, p.801, 830) proposed the following sequence (drawing heavily on the work of SCHLÜTER, 1871, 1876), all of which he regarded as Campanian because he did not recognise a Maastrichtian stage:

Upper Campanian	{	<i>Pachydiscus neubergicus</i>
		<i>Hoplites vari</i>
Lower Campanian	{	<i>Mortoniceras delawarensis</i>
		<i>Placenticeras bidorsatum</i>

A zone of *Bostrychoceras polyplacum* was introduced by HAUG (1911, pp. 1170, 1300) and usually regarded by him as Maastrichtian. Subsequent workers have generally adopted a three or four-fold Campanian zonation, with a *vari* or *polyplacum* Zone at the summit; the Maastrichtian was then assigned either to a *Pachydiscus neubergicus* Zone or a *Scaphites* (*Hoploscaphites*) *constrictus* Zone, as with JELETZKY (1951). This author also proposed a more refined scheme for the Maastrichtian, with a lower Zone of *Pachydiscus neubergicus* + *Scaphites* (*Acanthoscaphites*) *tridens* et var., and an upper Zone of *Sphenodiscus binkhorsti*.

WRIGHT (1957) gave the following divisions for "classic areas of western Europe" (table 4, p.L128):

Maastrichtian	{	<i>Sphenodiscus</i> sp.
		<i>Pachydiscus neubergicus</i>
Campanian	{	<i>Hoplitoplacenticeras vari</i>
		<i>Menabites delawarensis</i>
		<i>Diplacmoceras bidorsatum</i>

This zonation or variations of it were quoted by ammonite workers until 1980 when BLASZKIEWICZ produced the most significant account of uppermost Campanian and Maastrichtian ammonites from Europe on the basis of the succession in some 460 m of chalks, marls, siliceous limestones (opokas) and siliceous gale in the central Vistula Valley. We are most grateful to Dr A. BLASZKIEWICZ for allowing us to study his collections and to Dr R. MARCINOWSKI for guidance in the field. BLASZKIEWICZ both provided a comprehensive review

of previous work and recognised the following zonal succession:

	Belemnite zones	Ammonite zones	
Upper	{	<i>Hoploscaphites constrictus crassus</i>	
		<i>Belemnella casimirovensis</i>	
		<i>Belemnitella junior</i>	
Lower	{		
		<i>Belemnitella occidentalis</i>	
		<i>Belemnella lanceolata lanceolata</i>	
Upper	{	{	
		<i>Belemnitella langei</i>	{
		<i>Belemnitella minor</i>	<i>Nostoceras pozaryskii</i>
		<i>Belemnitella mucronata</i> s.l.	<i>Didymoceras donezianum</i>
			<i>Bostrychoceras polyplacum</i>
			<i>Neancyloceras phaleratum</i>

Note that BLASZKIEWICZ did not offer ammonite indices to correspond with the first three belemnite zones of the Maastrichtian.

The highest Campanian ammonite zone should be renamed the Zone of *Nostoceras hyatti*, following BURNETT *et al.*, (in press) and KENNEDY & COBBAN (in press), because BLASZKIEWICZ's material of *Nostoceras pozaryskii* includes specimens of the widely occurring *Nostoceras* (*N.*) *hyatti* STEPHENSON, and more restricted *Nostoceras* (*N.*) *helicinum* (SHUMARD). Also present in the *hyatti* Zone of the Vistula Valley are: *Hoploscaphites vistulensis* BLASZKIEWICZ, *H. angulatus* (LOPUSKI), *H. minimum* BLASZKIEWICZ, *Jeletzkytes nodosus* (OWEN) (the senior synonym of *Acanthoscaphites praequadriscopinosus* BLASZKIEWICZ: KENNEDY & COBBAN, in press), *Baculites* spp., including *B. leopoliensis* NOWAK (personal observations). *Neancyloceras* aff. *bipunctatum* (SCHLÜTER), *Pachydiscus perfidus* DE GROSSOUVRE, *P.* cf. *colligatus latiumbolicatus* BLASZKIEWICZ, *Pseudokosmaticeras galicianum* (FAVRE), *Pseudophyllites indra* (FORBES), *Placenticeras meeki* BÖHM, *Hauericeras* aff. *sulcatum* (KNER) and *Belemnitella langei* JELETZKY.

The sequence of species in this zone is stated by BLASZKIEWICZ to be as follows:

"The *Nostoceras pozaryskii* Zone. In the assumed concept of the zone, its lower boundary is determined by the appearance of *Acanthoscaphites praequadriscopinosus* sp.nov., while the first occurrence of the index species is considered as pronouncedly later. In the case of upper boundaries of true ranges of the two taxons, the possibility was assumed of an only insignificant departure from the upper boundary of the unit. The remaining taxons here occurring and having more closely

determined true ranges include *Pachydiscus perfidus* Grossouvre, *Hoploscaphites minimus* sp.nov. and *Belemnella langei* Jeletzky.

The true range of *Pachydiscus perfidus* Grossouvre is seen as approaching that of *Acanthoscaphites praequadriscopinus* sp.nov. The position in the roof part or only slightly above the upper boundary of the zone is also assumed in the case of the upper boundary of the true range passing from the former unit of *Belemnella langei* Jeletzky. *Hoploscaphites minimus* sp.nov. is a species decidedly passing to the next unit and whose appearance is related with the upper part of the zone." (BLASZKIEWICZ, 1980, p.14).

As discussed elsewhere (KENNEDY, COBBAN & SCOTT, 1992) these records of *Jeletzkytes nodosus* (OWEN) (= *Acanthoscaphites praequadriscopinus* of BLASZKIEWICZ), *Nostoceras* (*N.*) *hyatti* and *N.* (*N.*) *helicinum* (= *Nostoceras pozaryskii*), within the Upper Campanian are crucial to the placement of the Campanian-Maastrichtian boundary in the US Western Interior and Gulf Coast, and elsewhere.

The *Belemnella lanceolata lanceolata* Zone of BLASZKIEWICZ yields *Baculites* spp., *Nostoceras* sp., *Nostoceras schloenbachi* (FAVRE), *Diplomoceras cylindraceum*, *Hoploscaphites minimum* BLASZKIEWICZ, *Acanthoscaphites tridens* (KNER) [= *A. quadriscopinus* (GEINITZ)] and *A. bispinosus* NOWAK of BLASZKIEWICZ], *Pachydiscus neubergicus* [= subspecies *raricostatus* BLASZKIEWICZ], *Pachydiscus epiplectus* (REDTENBACHER) [= *Pachydiscus colligatus latiumbolicatus* BLASZKIEWICZ], *Pseudokossmaticeras galicianum* and *Belemnella lanceolata*. In his discussion of this zone BLASZKIEWICZ (1980, p.14) suggests that, contrary to records in Germany, *Hoploscaphites constrictus* appears some way above the first occurrence of *B. lanceolata* and *A. tridens*, as does *Pachydiscus neubergicus raricostatus* BLASZKIEWICZ (regarded as a synonym of *P. neubergicus* by KENNEDY & SUMMESBERGER, 1984). In the Mięchów region, some 30 km north of Kraków, *P. neubergicus raricostatus* and *B. lanceolata* appear at the same level according to BLASZKIEWICZ.

The upper Lower Maastrichtian *Belemnella occidentalis* Zone of BLASZKIEWICZ yielded *Baculites* spp., *Hoploscaphites constrictus* [subspecies *anterior* of BLASZKIEWICZ], *Acanthoscaphites tridens* [*bispinosus* NOWAK of BLASZKIEWICZ], *Pachydiscus neubergicus neubergicus*, *P. gollevillensis* (d'ORBIGNY) [subspecies *nowaki* MICHAILOV of BLASZKIEWICZ], *Hauericeras sulcatum* and *Belemnella occidentalis*.

The lower Upper Maastrichtian *Belemnella junior* Zone of BLASZKIEWICZ yields only *Baculites* species.

The base of the upper Upper Maastrichtian *Hoploscaphites constrictus crassus* Zone of BLASZKIEWICZ is said to be below the appearance of *Belemnella casimirovensis* (SKOLOZDROWNA), suggesting that the upper limit of the *junior* Zone is drawn at a lower level in the Vistula Valley than elsewhere in Europe. Apart from the index species, which is no more than a late form of *H. constrictus*, the ammonites are *Baculites* spp., *Diplomoceras cylindraceum*, *Acanthoscaphites varians* (LOPUSKI) and *Sphenodiscus binkhorsti* (BÖHM).

Ammonite zonations of the Maastrichtian have been proposed recently for the coastal succession of the Biscay region. The chief outcrops are at Zumaya and Sopenana in Spain, and at Hendaye and Bidart in France. A review of previous work in the region is provided by WARD & KENNEDY (in press), to which reference should be made. The Maastrichtian succession at Zumaya is more than 200 m in thickness, and five members can be recognized, and traced to the other sections. Planktic foraminiferal zonation of the succession at Zumaya is based on the work of HERM (1965), and a nannofossil zonation is provided by BURNETT *et al.* (1992). WIEDMANN (1987, 1988a,b) proposed a tentative ammonite zonation for the Zumaya section as follows:

(top 12 m unzoned)

*Pachydiscus epiplectus* species-level  
*Pachydiscus jacquoti* species-level  
*Pachydiscus llarenai* species-level  
*Pachydiscus gollevillensis* species-level  
*Anapachydiscus fresvillensis* species-level  
 Zone of *Pachydiscus neubergicus*  
 Zone of *Pseudokossmaticeras tercense*

*Nostoceras* (*N.*) *hyatti* occurs in the *tercense* Zone, for *Cirroceras* (*Cirroceras*) *polyplacum zumayense* WIEDMANN 1962, p.200, pl.9, fig. 5) is based on a body chamber of *N. (N.) hyatti*. The *tercense* Zone is thus, in part at least, Campanian. The holotype of *Pachydiscus (P.) llarenai* WIEDMANN (1960, p.764, pl.4, fig. 6; pl.5, fig. 4) is a crushed *P. (P.) jacquoti*, so it is unlikely that the *jacquoti* and *llarenai* species-levels can really be distinguished. *Pachydiscus epiplectus* (REDTENBACHER), used by WIEDMANN to distinguish his top Upper Maastrichtian species-level, is in fact a Lower Maastrichtian species (KENNEDY & SUMMESBERGER, 1986). WARD *et al.* (1991) and WARD & KENNEDY (in press) have presented new range-data from all the main sections in the Biscay region, the second paper providing, for the first time, illustrations and taxonomic revisions of the whole ammonite-fauna. They show that some of WIEDMANN's species-levels overlap, and have proposed the following zonation:

(youngest)

*Anapachydiscus terminus* Zone  
*Anapachydiscus fresvillensis* Zone  
*Pachydiscus (P.) epiplectus* Zone  
*Pseudokossmaticeras tercense* Zone  
 (oldest)

As already noted, the presence of *Nostoceras (N.) hyatti* in the *tercense* Zone at Zumaya shows that it is in part Campanian. In ammonite terms, the *tercense* Zone at Tercis is contiguous with, but does not overlap with definite Maastrichtian ammonites. However, detailed correlation depends on other groups of fossils and is discussed in the preceding paper. Other key criteria for a correlation between the Biscay region and Tercis are:

1) The base of the Zone of *Anapachydiscus fresvillensis*, recognised in the Biscay sections and at La Pointe (just north of Tercis Quarry), is correlated approximately with the base of the Zone of *Belemnitella junior* because *A. fresvillensis* first appears in the *junior* Zone in the Maastricht area (KENNEDY, 1987) and is unknown below.

2) The base of the Zone of *Anapachydiscus terminus* can be placed in the upper part of the Zone of *Belemnella casimirovensis*, and more precisely, at the base of the *stevensis-chitoniformis* micro-brachiopod Zone (SURLYK, 1984), on the basis of the occurrence of *A. terminus* in this zone in Denmark (the *Anapachydiscus* aff. *fresvillensis* of BIRKELUND, in press, is based on *A. terminus*).

### The Campanian-Maastrichtian ammonite succession around Tercis

We propose the following ammonite zonation for the uppermost Campanian and Maastrichtian of the Tercis region:

Maastrichtian	{	[ <i>Menuites</i> [ <i>Anapachydiscus</i> ] <i>terminus</i> Zone: not proven]
		<i>Menuites</i> [ <i>Anapachydiscus</i> ] <i>fresvillensis</i> Zone
		<i>Pachydiscus epiplectus</i> Zone (gap?)
Upper Campanian (part)		<i>Nostoceras hyatti</i> Zone

These are all assemblage-zones. The Zone of *Nostoceras hyatti* is characterised by the occurrence of *Hauericeras fayoli* (DE GROSSOUVRE, 1894), *Pseudokossmaticeras brandti* (REDTENBACHER, 1873), *P. tercense* (SEUNES, 1892), *Pachydiscus* (*Pachydiscus*) *perfidus* (DE GROSSOUVRE, 1894), *P. (P.) subrobustus* (SEUNES, 1892), *P. (P.)* cf. *colligatus* (BINKHORST, 1861), *Nostoceras* (*Nostoceras*) *hyatti* STEPHENSON, 1941, *N. (N.) helicinum* (SHUMARD, 1861) and *Baculites leopoliensis* NOWAK, 1908. The zonal fauna is already present in the top 8 m of Unit G of the Tercis Pale Flint Member, and *P. tercense* and *B. leopoliensis* extend to Unit N2, near the top of the Member. *N. (N.) hyatti* itself is known only below Unit M. The *hyatti* Zone is equivalent to most or all of the Zone of *Pseudokossmaticeras tercense* of the Biscay region (WARD & KENNEDY, in press), and part or all of the Zone of *N. hyatti* [*pozaryskii*] of the Vistula Valley in Poland (BLASZKIEWICZ, 1980).

The Zone of *Pachydiscus epiplectus* is characterised by the co-occurrence of *P. (P.) epiplectus* (REDTENBACHER, 1873), *P. (P.) neubergicus* (VON HAUER, 1858) and *Hoploscaphites constrictus* (J. SOWERBY, 1817). These first occur in Unit N3 of the Tercis Pale Flint Member; *H. constrictus* is present in the basal marl of

Unit N3, and is the lowest unequivocally Maastrichtian ammonite found at Tercis to date.

The Zone of *Menuites* [*Anapachydiscus*] *fresvillensis* is recognised on the basis of faunas from the higher part of the succession exposed at La Pointe, and includes *Pachydiscus jacquoti jacquoti* (SEUNES, 1890a), *Pachydiscus* (*Pachydiscus*) *armenicus* ATABEKIAN & AKOPIAN, 1969, *Desmophyllites larteti* (SEUNES, 1892), and *Glyptoxoceras rugatum* (FORBES, 1846).

We have seen no indicators of the *Menuites* [*Anapachydiscus*] *terminus* Zone from the Tercis area; whether this is due to collection-failure or its absence from the highest Maastrichtian preserved cannot be determined at this time.

We have also seen but are unable to localise stratigraphically with certainty the following species of the Maastrichtian: *Anagaudryceras lueneburgense* (SCHLÜTER, 1872), *Saghalinites wrighti* BIRKELUND, 1965, and *Pseudokossmaticeras duereri* (REDTENBACHER, 1873). From material in the Bruno Cahuzac collection, the first two species come from the *epiplectus* Zone.

### Conventions

The following abbreviations are used to indicate the repositories of specimens mentioned in the text: BMNH: Natural History Museum, London; OUM: University Museum, Oxford; MNHP: Muséum National d'histoire Naturelle, Paris; SP: Sorbonne Collections, now housed in the Université Pierre et Marie Curie, Paris; these are uncatalogued but include the ARNAUD collection. Type and figured material of the old Sorbonne collections is currently being transferred to the MNHP collections; UPST: Université Paul Sabatier, Toulouse; FSL: Collections of Département des Sciences de la Terre, Université Claude Bernard, Lyon, which also houses the EMP (École des Mines) Collections. USNM: United States National Museum, Washington, D.C., USA. IRSNB: Institut Royal des Sciences Naturelles de Belgique.

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

### Systematic palaeontology

#### Phylum Mollusca

Class **Ammonoidea** ZITTEL, 1884

Suborder **Lytoceratina** HYATT, 1889

Superfamily TETRAGONITACEAE HYATT, 1900

Family GAUDRYCERATIDAE SPATH, 1927



Genus *Anagaudryceras* SHIMIZU, 1934

## TYPE SPECIES

*Ammonites sacya* FORBES, 1846, p.113, pl.14, fig.9, by original designation of SHIMIZU, 1934, p.67.

*Anagaudryceras lueneburgense* (SCHLÜTER, 1872)

(Pl.1, Figs.8-10; Pl.2, Figs.12,13)

## compare:

\*1872 *Ammonites Lüneburgensis* SCHLÜTER, p.62, pl.18, figs. 8-9.

1894 *Gaudryceras planorbiforme* J. Böhm - DE GROSSOUVRE, p.231, (pars), pl.27, fig.2 only.

1986 *Anagaudryceras lueneburgense* (Schlüter, 1872) - KENNEDY & SUMMESBERGER, p.185, pl.3, fig.6; pl.15, fig.4.

in press *Anagaudryceras lueneburgense* (Schlüter, 1872) - BIRKELUND, p.00, pl.1, figs.3-5.

## DESCRIPTION AND DISCUSSION

The original of *Gaudryceras planorbiforme* BÖHM of DE GROSSOUVRE (1894, p.231 (pars), pl.27, fig.2 only), represents the juvenile of this species. It is a poorly preserved composite mould (Pl.2, Figs.12,13), just over 53 mm in diameter, the whorls slowly expanding, serpentine, with an umbilicus comprising 44% of the diameter. The outer whorl is worn, and no ornament survives. There are distant, prorsiradiate, straight to feebly flexuous collar-ribs and associated constrictions, three per half whorl.

A second crushed composite mould, MNHP 2001.A.227 (Pl.1, Figs 8-10) is just over 100 mm in diameter, with the whorl height comprising 34% of the diameter and the umbilicus 40.7%. Distant flexuous constrictions with associated collar-ribs are present throughout, and the specimens, although poor, can be referred to *Anagaudryceras lueneburgense* as revised by KENNEDY & SUMMESBERGER (1986) and BIRKELUND (1982; in press).

## Family TETRAGONITIDAE HYATT, 1900

Genus *Saghalinites* WRIGHT & MATSUMOTO, 1954

## TYPE SPECIES

*Ammonites cala* FORBES, 1846, p.104, pl.8, fig.4, by original designation of WRIGHT & MATSUMOTO, 1954, p.10.

*Saghalinites wrighti* BIRKELUND, 1965

(Pl.1, Fig.5-7; Pl.12, Fig.5)

\*1965 *Saghalinites wrighti* BIRKELUND, p.30, pl.1, fig.5; pl.2, figs.1-5; pl.3, fig.1; text-fig. 14-25.

1986 *Saghalinites wrighti* Birkelund - KENNEDY & SUMMESBERGER, p.186, pl.1, figs. 4,5,7; pl.3, fig.4; text-fig. 3 (with full synonymy).

## TYPE

The holotype by original designation is no. 9747 in the collections of the Mineralogical Museum, Copenhagen, the original of BIRKELUND, 1965, pl.2, figs. 5a-c; text-fig. 19, from the reworked Maastrichtian concretions in the basal Danian Oyster-ammonite Conglomerate of Nûgssuaq, West Greenland.

## MATERIAL

SP unregistered, ex ARNAUD Collection, one specimen (the smaller: Pl.12, Fig.5) labelled "Angoumé, P<sup>3</sup>Q"; the larger (Pl.1, Figs.5-7) labelled "Tercis, banc à *Echinocorys conoidea* P3, Determin. De Grossouvre".

The smaller specimen (Pl.12, Fig.5) is a composite internal mould of a juvenile with a maximum preserved diameter of 31 mm. Coiling is very evolute, the umbilicus comprising 47% of the diameter, shallow, with a flattened wall and narrowly rounded umbilical shoulder. The whorl section has been modified by *post-mortem* compaction, but appears to have been parallel-sided with a rounded venter. The surface of the mould is smooth, but for distant straight prorsiradiate constrictions.

The larger specimen (Pl.1, Figs.5-7) is a composite mould deformed into an ellipse with a major axis 67 mm in diameter, and two thirds of a whorl of body chamber preserved. Coiling is fairly involute, the umbilicus of moderate depth, with a concave wall and narrowly rounded shoulder. The whorl section is slightly depressed, with flattened inner flanks, convergent outer flanks, narrowly rounded ventrolateral shoulders and a flattened venter. There is no ornament and no constrictions are visible.

## DISCUSSION

*Saghalinites wrighti* most closely resembles the type species, *S. cala* (FORBES, 1846), recently revised by KENNEDY & HENDERSON (1992a). They differ in that *S. wrighti* has straight constrictions, whereas those of *S. cala* are flexed, and it is on this criterion that the present material is placed in BIRKELUND'S species.

## OCCURRENCE

Lower Maastrichtian of Neuberg, Steiermark, Austria; in Greenland, north Germany and Denmark it occurs around the Lower/Upper Maastrichtian boundary. In the coastal outcrops in the Biscay region of France and Spain it ranges from the Lower Maastrichtian into the upper Upper Maastrichtian.

Genus *Pseudophyllites* KOSSMAT, 1895

## TYPE SPECIES

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

*Pseudophyllites indra* (FORBES, 1846)

(Pl.1, Figs.3-4)

- \*1846 *Ammonites Indra* FORBES, p.105, pl.11, fig.7.  
 1992a *Pseudophyllites indra* (Forbes, 1846) - KENNEDY & HENDERSON, p.398, pl.3, figs.7-9, 13-27; pl.4, figs.1-3 (with full synonymy).  
 in press *Pseudophyllites indra* (Forbes, 1846) - WARD & KENNEDY.

## LECTOTYPE

Designated by KENNEDY & KLINGER, 1977, p.182, is BMNH C 51068, the original of FORBES, 1846, pl.11, figs. 7a,b, from the Valudavur Formation of Pondicherry, south India. There are numerous paralectotypes.

## MATERIAL

MNHP 7192 (ex D'ORBIGNY Collection), from Tercis.

## DISCUSSION

Although only a juvenile, the form of the umbilicus shows this specimen to be *Pseudophyllites indra*. Differences from other species are fully documented by KENNEDY & HENDERSON (1992a).

## OCCURRENCE

(Upper Santonian?) Lower Campanian to Upper Maastriichtian: south India, South Africa (Zululand and Pondoland), Colombia, Brazil (?), Chile, California, the US Gulf Coast, New Jersey (USA), Northern Ireland, Poland, Austria, France (Pyrénées-Atlantiques, Landes, and northern Aquitaine).

Suborder *Ammonitina* HYATT, 1889

Superfamily DESMOCERATAEAE ZITTEL, 1895

Family DESMOCERATIDAE ZITTEL, 1895

Genus *Desmophyllites* SPATH, 1929

## TYPE SPECIES

*Desmoceras larteti* SEUNES, 1892, p.19, pl.12 (3), fig.2; pl.13, (4), figs.2,3, by subsequent designation of SPATH, 1921, p.46, as type species of *Schlueteria*, of which *Desmophyllites* is the replacement name.

*Desmophyllites larteti* (SEUNES, 1892)

(Pl.2, Figs.1-3,10,11,14; Pl.3, Figs.1,4,5)

- \*1892 *Desmoceras Larteti* SEUNES, p.19, pl.12 (3), fig.2; pl.13 (4), figs.2,3.  
 1984 *Desmophyllites larteti* (Seunes, 1891) - KENNEDY & SUMMESBERGER, p.156, pl.1, fig.6; pl.2, figs.1-3, 5-6 (with full synonymy).  
 1992a *Desmophyllites larteti* (Seunes, 1891) - KENNEDY & HENDERSON, p.407.  
 in press *Desmophyllites larteti* (Seunes, 1891) - WARD & KENNEDY, p. ,fig.

## TYPES

Lectotype, designated by KENNEDY & SUMMESBERGER (1984, p.156) is the original of SEUNES, 1892, pl.13 (4),

fig.2; paralectotype is the original of SEUNES, 1892, pl.12 (3), fig.2; pl.13 (4), fig.3, and from the "Assise à *Pachydiscus Fresvillensis*, *P. Jacquoti* et *Stegaster*, Gan, Route de Gan à Rébénacq", Pyrénées-Atlantiques, France; SP unregistered.

## MATERIAL

SP unregistered, ex ARNAUD collection, two specimens labelled "*Pachydiscus Larteti* Seunes Tercis, La Pointe, P<sup>3</sup> R. Détermn. de Grossouvre", a further specimen from the same locality, and labelled "*Ammonites n.sp*". SP unregistered, ex ARNAUD Collection, two specimens labelled "*Schlueteria Larteti* de Gross. Angoumé".

## DIMENSIONS

	<i>D</i>	<i>Wb</i>	<i>Wh</i>	<i>Wb:Wh</i>	<i>U</i>
Lectotype	93.5(100)	23.3(24.9)	51.3(54.9)	0.45	5.3(5.7)
Paralectotype	81.4(100)	24.0(29.5)	41.0(50.4)	0.58	5.1(6.3)

## DESCRIPTION

The type specimens are composite moulds showing little, if any, indications of *post-mortem* crushing. The lectotype has 160° of body chamber preserved; the paralectotype 50°. Both have their early whorls restored in Plaster of Paris, as is clearly shown in SEUNES' figures. Coiling is very involute, with a tiny umbilicus comprising around 6% of diameter, shallow, with a flattened umbilical wall and narrowly rounded umbilical shoulder. The whorl section is compressed oval, with a whorl breadth to height ratio of 0.45-0.58, the greatest breadth below mid-flank, the inner flanks broadly rounded, the outer flanks convergent and the venter narrowly arched. Phragmocones appear smooth, but for traces of constrictions visible at the smallest diameter in the paralectotype. These are much more conspicuous towards the end of the phragmocone and on the body chamber, where they come to number 5-6 per half whorl. They are narrow, deep, distant, prorsiradiate and biconcave, being concave on the inner flank, convex at mid-flank and concave on the outer flank, sweeping strongly forwards over the ventrolateral shoulder to cross the venter in a narrow linguoid convexity. The constrictions are preceded by a rounded collar-rib, weak on the inner flanks, but strengthening on the outer flank and best developed over the venter. Interspaces between constrictions bear delicate growth lines and striae; these are most conspicuous on the venter. Suture with narrow-stemmed, symmetrically bifid saddles; L deeply incised; there are numerous auxiliary saddles on the umbilical lobe.

The Tercis specimens are typical wholly septate fragments with whorl heights of up to 40 mm. Those from Angoumé are better preserved, up to an estimated 110 mm diameter, and appear to be adult.

## DISCUSSION

*Desmophyllites diphylloides* (FORBES, 1846) (p.105, pl.8, fig.8; see HENDERSON & MCNAMARA 1985, p.54,

pl.4, figs.1-4) is a smaller, stouter species with flattened subparallel flanks (whorl breadth to height ratios of 0.85-0.76 are cited by HENDERSON & MCNAMARA), broadly rounded venter and shallow constrictions that are weaker than those of *D. larteti* and only feebly flexed in most described examples.

#### OCCURRENCE

Upper Campanian to upper Upper Maastrichtian. There are records from the Gschliefgraben, Austria; Landes, Pyrénées-Atlantiques and the Biscay region of south-eastern France and northern Spain and, possibly, Madagascar.

Subfamily HAURICERATINAE MATSUMOTO, 1938  
Genus *Hauriceras* DE GROSSOUVRE, 1894

#### TYPE SPECIES

*Ammonites gardeni* BAILY, 1855, p.450, pl.11, fig.3, by original designation of DE GROSSOUVRE, 1894, p.219.

*Hauriceras fayoli* DE GROSSOUVRE, 1894  
(Pl.1, Figs. 1,2)

\*1894 *Hauriceras fayoli* DE GROSSOUVRE, p.220 (pars), pl.27, fig.3.

1986a *Hauriceras fayoli* De Grossouvre, 1894 - KENNEDY, p.27, text-fig.9a-j.

#### TYPE

Holotype by monotypy, is SP unregistered, ex ARNAUD collection, the original of DE GROSSOUVRE, 1894, pl.27, fig.3. Said to be from Assise Q of Arnaud at Montmoreau (Charente), it is, by its preservation, from Tercis.

#### MATERIAL

OUM KZ 20331, from the Upper Campanian *N. (N.) hyatti* Zone, Unit H at Tercis.

#### DESCRIPTION

The holotype is a crushed composite mould just over 60 mm in diameter. Coiling is very evolute with a broad, shallow umbilicus comprising 48% of the diameter with a very low wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with subparallel flanks and a narrow, somewhat worn venter. The surface of the mould is smooth, but for distant constrictions, four per whorl. They are narrow, straight and prorsiradiate on the inner flank, convex at mid-flank, concave on the outer flank and strongly projected on the ventrolateral shoulder.

#### DISCUSSION

KENNEDY & SUMMERSBERGER (1984) and KENNEDY (1986a) describe and discuss *H. fayoli* in detail, and note differences from other species referred to the genus.

#### OCCURRENCE

Upper Campanian of the Gschliefgraben, Austria. There are imprecisely located specimens from northern Aquitaine and Tercis; the latter, by their preservation, are from the Upper Campanian *N. (N.) hyatti* Zone; and doubtful records from the Lower Maastrichtian of Madagascar.

Family KOSSMATICERATIDAE SPATH, 1922  
Subfamily KOSSMATICERATINAE SPATH, 1922  
Genus *Pseudokossmaticeras* SPATH, 1922

#### TYPE SPECIES

*Ammonites pacificus* STOLICZKA, 1865, p.160, pl.77, fig.9, by original designation of SPATH, 1922, p.126.

*Pseudokossmaticeras brandti* (REDTENBACHER, 1873)  
(Pl.2, Figs.4-6; Pl.4, Figs.1-5; Pl.5, Figs.1-8; Pl.6, Figs. 1-9; Pl.7, Figs.5-11)

\*1873 *Ammonites brandti* REDTENBACHER, p.106, pl.24, fig.1.

1892 *Pachydiscus aturicus* SEUNES, p.17, pl.15(6), figs. 2, 3.

1894 *Pachydiscus brandti* (Redtenbacher) - DE GROSSOUVRE, p.192, pl.23, figs.2,3 (non pl.30,fig.3, var. *pegoti* DE GROSSOUVRE = *P.tercense* (SEUNES, 1892)).

1925 *Kossmaticeras brandti* (Redtenbacher) - DIENER, p.97.

non 1935 *Kossmaticeras brandti* (Redtenbacher) - TZANKOV, p.11, pl.3, fig.2, (= *P. galicianum* (FAVRE, 1869)).

1935 *Kossmaticeras brandti* (Redtenbacher) - BRINKMANN, p.6.

1951 *Pseudokossmaticeras brandti* (Redtenbacher) - MICHAILOV, p.75, pl.11, fig.48.

1955 *Pseudokossmaticeras brandti* (Redtenbacher) - MATSUMOTO, p.144.

1958 *Pseudokossmaticeras brandti* (Redtenbacher) - REYMENT, p.34, pl.10, fig.1.

1959 *Pseudokossmaticeras brandti* (Redtenbacher) - NAIDIN & SHIMANSKY, p.190, pl.13, fig.2.

1960 *Pseudokossmaticeras brandti* (Redtenbacher) - WIEDMANN, p.724.

non 1964 *Pseudokossmaticeras brandti* (Redtenbacher) - TZANKOV, p.156, pl.3, fig.1 (= *P. galicianum* (FAVRE, 1869)).

1976 *Pseudokossmaticeras brandti* (Redtenbacher) - THIEDIG & WIEDMANN, p.15, pl.1, fig.1.

non 1981 *Pseudokossmaticeras brandti* (Redtenbacher, 1873) - SZASZ, p.102, pl.5, figs.1,2 (= *Nowakites* sp).

1982 *Pseudokossmaticeras brandti* (Redtenbacher, 1873) - TZANKOV, p.30, pl.12, figs.1-3.

1982 *Pseudokossmaticeras aturicus* (Seunes, 1890) - TZANKOV, p.32, pl.14, fig.1.

1989 *Pseudokosmaticeras brandti* (Redt.) - SALAJ & WIEDMANN, p.303, text-fig.3.

#### LECTOTYPE

No 1873/01/11 in the collections of the Geologische Bundesanstalt, Vienna, the original of REDTENBACHER 1873, p.106, pl.24, fig.1, from the Gosau Beds of Grünbach, Austria, designated by REYMENT, 1958, p.34.

#### MATERIAL

There are numerous unregistered specimens from Angoumé and Tercis in the SP, EMP, and UPST Collections, including the originals of SEUNES, 1892, pl.15(6), figs. 2,3, the types of *Pachydiscus aturicus* SEUNES, 1892, in the EMP and SP collections respectively; a cast of the original of DE GROSSOUVRE, 1894, pl.23, fig.1 is in the EMP collections, while the original of DE GROSSOUVRE 1894, pl.33, figs.2,3, is in the SP collections; OUM KZ 16871, probably from the Pale Grey Flint Member at Tercis.

#### DIMENSIONS

	<i>D</i>	<i>Wb</i>	<i>Wh</i>	<i>Wb:Wb</i>	<i>U</i>
SEUNES, 1892, pl.15(6), fig.3	58.5(100)	26.0(44.4)	22.3(38.1)	1.17	22.3(38)
SEUNES, 1892, pl.15(6), fig.2.	87.3(100)	(-)	31.2(35.7)	1	34.0(39.0)

#### DESCRIPTION

An early growth stage is shown by the juvenile 62 mm in diameter, shown as Pl.5, Figs.1,2, and the inner whorls of the original of SEUNES, 1892, pl.15(6), fig.3, 58.5 mm in diameter (Pl.7, Figs.5-8, 11). Coiling is very evolute, the umbilicus comprising 38% of the diameter, of moderate depth with a broadly rounded, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is depressed reniform, with a whorl breadth to height ratio of 1.17, the greatest breadth below mid-flank, the flanks and venter broadly and evenly rounded. Twenty primary ribs arise at the umbilical seam and strengthen across the umbilical wall, developing into pronounced bullae that extend across the inner half of the flanks at the smallest diameter seen, but as size increases the bullae give rise to single ribs that are coarse, straight and prorsiradiate. They branch both low and high on the flank and additional ribs may intercalate to give a total of twenty six ribs on the venter of the last half whorl, where they are feebly convex. The ribs strengthen progressively as size increases. There are six to seven prominent constrictions per whorl. They are deeply incised into the umbilical shoulder, broad and deep, straight on the inner flank but flexed forwards on the outer flank to become feebly concave; they cross the venter in a broad convexity which is, however, narrower than the convexity of the ribs. These constrictions are flanked by sharp, narrow, adapical and adapertural collar ribs with sharp umbilical bullae. Other specimens of this size show some variability in the coarseness of ribbing with seventeen primaries on the inner whorls of

the larger of SEUNES specimens (Pl.4, Figs.1-3) and as few as fifteen in others (Pl.7, Fig.9). The later whorls, which extend to diameters of 150 mm, are characterised by the disappearance of clearly differentiated constrictions beyond 90 mm diameter, and a change to predominantly primary ribs, 24-26 per whorl, with well-developed bullae, the ribs coarse, straight and prorsiradiate on the inner and mid-flank, flexing forwards on the ventrolateral shoulder to cross the venter undiminished in strength, in a feebly convex to near-transverse course. There are occasional intercalated ribs that arise both low and high on the flank present to the largest diameters seen, with rib totals of up to 33 per whorl.

#### DISCUSSION

The lectotype of *Pseudokosmaticeras brandti* is a near-complete adult (REYMENT, 1958, pl.10, fig.1), deformed into an ellipse with a maximum diameter of 153 mm, lacking the internal whorls, and differing in no obvious respects other than preservation from comparable-sized Tercis specimens (Pl.4, Figs.4,5; Pl.5, Figs.7,8).

*P. brandti* differs from co-occurring *Pseudokosmaticeras tercense* (SEUNES, 1892) (p.16, pl.15(6), fig.4) (see below) in that the latter is a compressed, slender-whorled species with delicately ribbed inner whorls, the ribs arising in pairs from bullae or intercalating between (Pl.7, Figs.1-4; Pl.8, Figs.1-6). *Pseudokosmaticeras galicianum* (FAVRE, 1869) (p.16, pl.3, figs.5,6; see KENNEDY & SUMMESBERGER, 1987) and its synonyms *P. negri* (MARIANI, 1898, p.34(4), pl.8(1), fig.3) and, possibly, *P. tchihatcheffi* BÖHM, 1927, p.217, pl.13, fig.1) has much finer narrow ribs, arising singly or in pairs from 26 umbilical bullae per whorl at a diameter of 55 mm, and a total of 47-50 ribs in the lectotype. *Pseudokosmaticeras muratovi* MICHAILOV, 1951 (p.77, pl.13, fig.32) is more densely ribbed than the present species, lacks prominent umbilical bullae, the ribs bi- and trifurcating at or about mid-flank to give a total of more than 50 ribs per whorl. *Pseudokosmaticeras cerevicianum* (PETHÖ, 1906) (p.95, pl.6, figs.2,3) is based upon four specimens from Fruska Gora; the original of PETHÖ'S pl.6, fig.3 (Pl.6, Figs.7-9) is here designated lectotype of the species; it and a paralectotype are shown as Pl.6, Figs.3-9. The original figures show shells with denser, branching ribs in middle growth, and exaggerated coarse bullae and ribs when adult, a quite different morphology from that of *P. brandti*. The specimens show, however, that the coarseness of adult ribbing is less striking than in the figures, and the result of clumsy cleaning of the specimens, and the fine ribs are equally an artefact. The lectotype and paralectotype can be matched in the present material, and *P. cerevicianum* is here regarded as a synonym of *P. brandti*.

#### OCCURRENCE

*Pseudokosmaticeras brandti* has been widely suggested as a Lower Maastrichtian marker. The species is restricted to the Upper Campanian (using the Campanian-

Maastrichtian boundary position adopted above) at Tercis. Few of the other records of the species (including the type material) can be precisely dated as Upper Campanian versus Lower Maastrichtian. An exception is the record from Carinthia (THIEDIG & WIEDMANN, 1960), which was dated as lower Lower Maastrichtian on the basis of associated benthic foraminifera, but may also be Campanian. In Tunisia the "Maastrichtian" record of SALAJ & WIEDMANN (1989) is Campanian in our terms. The species is known from Austria, the Balkans, France (Haute Garonne and Landes), the Subbetic Cordillera of Spain, Crimea, Caucasus and Tunisia.

*Pseudokossmaticeras tercense* (SEUNES, 1892)  
(Pl.7, Figs.1-4; Pl.8, Figs 1-6)

- 1890b *Pachydiscus* af. *galicianus* Favre - SEUNES, p.238, pl.9, fig.5.  
 \*1892 *Pachydiscus galicianus* Favre sp. mut. *Tercensis* SEUNES, p.16, pl. 15(6), fig.4.  
 1894 *Pachydiscus brandti* Redtenbacher sp. var. *Pégoti* DE GROSSOUVRE, p.194, pl.30, fig.3.  
 1925 *Kossmaticeras galizianum* var. *tercensis* Seunes - DIENER, p.98  
 1955 *Pseudokossmaticeras tercense* Seunes - COLLIGNON, p.44.  
 1959 *Pseudokossmaticeras galicianum* (Favre) - NAIDIN & SHIMANSKY, p.189, pl.13, fig.1.  
 1964 *Pseudokossmaticeras galicianum tercense* (SEUNES, 1890) - TZANKOV, p.158, pl.6, fig. 1; pl.7, fig.2.  
 1974 *Pseudokossmaticeras galicianum* (Favre 1869) - NAIDIN, p.179, pl.65, fig.4.  
 1976 *Pseudokossmaticeras tercense* (Seunes) - THIEDIG & WIEDMANN, p.18, pl.1, fig.2; pl.2, fig.2.  
 1986b *Pseudokossmaticeras tercense* (Seunes, 1891) - KENNEDY, p.1007, pl.1, figs.6,7.  
 in press *Pseudokossmaticeras tercense* (Seunes, 1891) - WARD & KENNEDY

TYPE

Lectotype (pl.7, figs. 3,4) by the subsequent designation of KENNEDY, 1986b, p.1008, is an unregistered specimen in the SP collections, the original of SEUNES, 1892, pl.15(6), fig.4; it is also the original of *Pachydiscus Brandti* REDTENBACHER var. *Pégoti* DE GROSSOUVRE, 1894, p.192, pl.30, fig.3, here designated lectotype of *Pseudokossmaticeras pégoti* DE GROSSOUVRE, which is thus an objective synonym of *P. tercense*.

MATERIAL

Numerous unregistered specimens from Tercis and Angoumé in the SP, EMP and UPST collections; OUM KZ 20324, from Unit N<sub>2</sub>, and OUM KZ 16914a-b, from the Pale Grey Flint Member, Tercis.

DESCRIPTION

The lectotype is a crushed composite mould, distorted into an ellipse with a major diameter of 80 mm. Coiling is moderately evolute, with 47% of the previous whorl being covered. The umbilicus comprises an estimated 34-35% of the diameter, and is shallow, with a low, flattened, subvertical wall and narrowly rounded umbilical shoulder. The specimen has suffered post-mortem crushing, but the whorl section appears to have been compressed, with feebly convex flanks and a relatively narrowly rounded venter. Much of the inner whorls to an estimated diameter of 45 mm are well-exposed within the umbilicus. An estimated 24 ribs arise at the umbilical seam, and strengthen across the umbilical wall, developing into delicate sharp bullae perched on the umbilical shoulder. These and other non-bullate ribs are narrow, sharp and prorsiradiate, the bullae giving rise to pairs of ribs in many cases, while there are additional intercalated ribs, and periodic broad constrictions flanked by narrow collar ribs. There are 24 umbilical bullae on the outer whorl of the holotype. They are narrow and sharp at the beginning of the outer whorl, thereafter coarsening progressively. They give rise to one, two or three ribs, while there are additional intercalated ribs; all are narrow, straight and prorsiradiate, and pass straight across the venter, totalling an estimated 55-60 ribs per whorl. There are no clearly defined constrictions. The last six or so ribs are much more widely spaced than those preceding them, linking the lectotype to larger specimens in the present collections (Pl.8, Figs.1-6). In adults, there are 23-24 primary ribs per whorl that arise from umbilical bullae for all but the final section of body chamber immediately prior to the aperture. The ribs are much narrower than the interspaces, straight and prorsiradiate on the flanks but flexed forwards and feebly concave over the ventrolateral shoulders and feebly convex to transverse on the venter; they crowd somewhat towards the adult aperture. Long and short intercalated ribs are frequent on the first half of the adult outer whorl, after which nearly all the ribs are long primaries.

DISCUSSION

The very fine, delicate ribbing of the inner whorls, distant, bar-like ribs on the outer whorl and compressed whorl section serve to distinguish *P. tercense* from co-occurring coarse ribbed *P. brandti*, as well as all other species referred to the genus.

OCCURRENCE

Upper Campanian of Landes and Haute Garonne in France; Zumaya, Guipuzcoa in Spain; possibly low Lower Maastrichtian of Carinthia, Austria. "Maastrichtian" (probably Upper Campanian in the sense used here) of Bulgaria and European Russia.

*Pseudokossmaticeras duereri* (REDTENBACHER, 1873)  
(Pl.2, Figs.7-9)

- \*1873 *Ammonites düreri* REDTENBACHER, p.118, pl.27, fig.2  
 1907 *Holcodiscus dureri* Redtenbacher - WISNIOWSKI, p.196.  
 1925 *Kossmaticeras Dürert* [sic] - DIENER, p.98.  
 1958 *Pseudokossmaticeras duereri* (Redtenbacher) - REYMENT, p.33, pl.7, fig.1  
 in press *Pseudokossmaticeras duereri* (Redtenbacher, 1873) - WARD & KENNEDY

## TYPE

The holotype is the original of REDTENBACHER, 1873, p.118, pl.27, fig.2, no. 1873/01/22 in the collections of the Geologische Bundesanstalt, Vienna, from Gosau, Austria.

## MATERIAL

SP unregistered, ex ARNAUD Collection, labelled "Tercis, Gde Carrière P3".

## DESCRIPTION

The specimen is a distorted composite mould of half a whorl, with a maximum preserved diameter of 45 mm. Coiling is very evolute, serpenticone, with a reniform whorl section. Numerous narrow primary ribs arise either singly or in pairs at the umbilical shoulder, in some cases from delicate bullae. The ribs are feebly prorsiradiate, straight on the inner flank and feebly concave on the outer. They are near-transverse on the venter. There is a single narrow, deep constriction on the fragment. It parallels the course of the primary ribs and is flanked by adapertural and adapical collar ribs.

## DISCUSSION

This fragment differs in no significant respects from the holotype, well-illustrated by REYMENT (1958, pl.7, fig.1). Differences from other species are discussed at length by WARD & KENNEDY (in press).

## OCCURRENCE

The age of the type occurrence is unknown. At Bidart (Pyrénées-Atlantiques, France), the species occurs low in the Maastrichtian as well as just below the Maastrichtian-Palaeocene boundary.

Family PACHYDISCIDAE SPATH, 1922

Genus and subgenus *Pachydiscus* ZITTEL, 1884

## TYPE SPECIES

*Ammonites neubergicus* VON HAUER, 1858, p.12, pl.2, figs.1-3; pl.3, figs.1,2, by the subsequent designation of DE GROSSOUVRE, 1894, p.177.

*Pachydiscus (Pachydiscus) neubergicus neubergicus*

(VON HAUER, 1858)

(Pl 3, Figs.6,7; Pl.9, Figs.5-8; Pl.12, Figs.7-9; Pl.13, Figs.5-7).

- \*1858 *Ammonites neubergicus* VON HAUER, p.12 (pars), pl.2, figs.1-3, non pl.3, figs.1,2.

?1985 *Pachydiscus (Pachydiscus)* cf. *neubergicus* (Hauer, 1858) - VAŠIČEK, p.76, pl.1, fig.3.

1986 *Pachydiscus (Pachydiscus) neubergicus* (Hauer, 1858) - KENNEDY & SUMMESBERGER, p.188, pl.2, figs.1,2; pl.3, figs.1-3; pl.4, figs.1-5; pl.5, figs.1,4,5; pl.6, figs.1,2,5; pl.15, figs.7,8; text-fig. 5a,b (with full synonymy).

1986c *Pachydiscus (Pachydiscus) neubergicus* (Hauer, 1958) - KENNEDY, p.34, pl.4, fig.3.

1992a *Pachydiscus neubergicus neubergicus* (Hauer, 1858) - KENNEDY & HENDERSON, p.420, pl.10, figs. 6,7,8; pl.11; text-fig. 6a.

in press *Pachydiscus neubergicus neubergicus* (Hauer, 1858) - WARD & KENNEDY

## TYPE

Lectotype is no. 1858.01.6 in the collections of the Geologische Bundesanstalt, Vienna, the original of VON HAUER, 1858, p.12, pl.2, figs.1,2 (refigured by KENNEDY & SUMMESBERGER, 1986, pl.3, figs.1-3), from Neuberg, Steiermark, Austria. Designated by DE GROSSOUVRE, 1894, p.209.

## MATERIAL

There are numerous unregistered specimens from Angoumé and Tercis in the SP, EMP and UPST collections, by their preservation from the Lower Maastrichtian *P.epipectus* Zone Tercis Dark Flint Member. The specimen figured by DE GROSSOUVRE (1894, pl.38, fig.3) has not been traced. Specimens collected *in situ* come from Unit N3 at Tercis: OUM KZ 12864, 12866 and 12868. Specimens collected loose (OUM KZ 16921, KZ 16922) suggest the species ranges higher in the section.

## DISCUSSION

The holotype and an extensive suite of paratypes were described and illustrated by KENNEDY & SUMMESBERGER (1986). The present material, although crushed, agrees closely with their specimens. *P. neubergicus neubergicus* and *P. neubergicus dissitus* HENDERSON & MCNAMARA, 1985 (p.72, pl.7, figs.7,9; pl.10, figs.3-6; text-figs. 11, 12c, 13c) have identical inner whorls, but whereas the former has mainly distant primary ribs on the outer whorl, the latter has many more secondary than primary ribs that persist to maturity. *Pachydiscus gollevillensis* (D'ORBIGBY, 1850) (see revision in KENNEDY, 1986c) has 9-11 umbilical bullae and around 80 secondary ribs per whorl: fewer bullae but more secondaries than *P. neubergicus*, while *Pachydiscus armenicus* ATABEKIAN & AKOPIAN, 1969 (p.8, pl.1, fig.2; pl.3, figs 1,2) (see revision in WARD & KENNEDY, in press) has more umbilical bullae (16-20 per whorl), and more ventral ribs (62-73 per whorl), than *P. neubergicus neubergicus*, where the figures are typically 14-18 and 48-60. *Pachydiscus jacquoti* (SEUNES, 1890a) (p.5, pl.3(2), figs.1-3) (see revision in KENNEDY, 1986c, p.34,

pl.5, figs.3-11, 15,19; pl.6; text-figs. 2d,e, 3, 4b, 5) has a subcircular whorl section, the coiling evolute and whorls slowly expanding; fewer, distant primary ribs and coarser, distant secondaries.

#### OCCURRENCE

*P. neubergicus neubergicus* has a total range from low in the Lower Maastrichtian to low in the Upper Maastrichtian, where it is succeeded by the subspecies *P. n. dissitus*. It is known from Tercis and other localities in Landes, Bidart and Hendaye in Pyrénées-Atlantiques, France; Zumaya, northern Spain; north Germany, Denmark, Poland, The Ukraine, Armenia, European Russia, Nigeria, Zululand (South Africa), Madagascar and south India. Subspecies *P. n. dissitus* is restricted to the Upper Maastrichtian of Western Australia.

#### *Pachydiscus (Pachydiscus) jacquoti jacquoti*

SEUNES, 1890a

(P.3, Fig.8; Pl.10, Figs.3,6)

- \*1890a *Pachydiscus jacquoti* SEUNES, p.5, pl.3(2), figs.1-3.  
 1890b *Pachydiscus jacquoti* Seunes - SEUNES, p.237, pl.9, figs.1-4.  
 1892 *Pachydiscus jacquoti* Seunes - SEUNES, p.9, pl.12(3), fig.4.  
 1960 *Pachydiscus llarenai* WIEDMANN, p.764, pl.4, fig.6; pl.5, fig.4.  
 1962 *Pachydiscus llarenai* Wiedmann - WIEDMANN, p.147, fig.39.  
 1986c *Pachydiscus (Pachydiscus) jacquoti* Seunes, 1890a - KENNEDY, p.34, pl.5, figs.3-11, 15-19; pl.6; text-figs. 2d,e, 3o,s, 4b (with full synonymy).  
 1986d *Pachydiscus (Pachydiscus) jacquoti* (Seunes, 1890) - KENNEDY, figs.9a,b.  
 1987 *Pachydiscus (Pachydiscus) jacquoti* (Seunes, 1890a) - KENNEDY, p.171, pl.11, figs.1-4; pl.12, figs.1-3, 8-10; pl.13, figs.1-5; pl.14, figs.4-6, 8-10; pl.15, figs.1-3,12,13; text-fig.7b.  
 1992a *Pachydiscus (Pachydiscus) jacquoti jacquoti* Seunes, 1890 - KENNEDY & HENDERSON, p.426.  
 in press *Pachydiscus (Pachydiscus) jacquoti jacquoti* Seunes, 1890 - WARD & KENNEDY.

#### TYPES

SEUNES figured three specimens (1890a pl.3(2), figs.1-3), and mentioned others from the Calcaire à *Baculites* of the Cotentin Peninsula, Manche, France, Pyrénées-Atlantiques, and north west of Alcoy, Spain. The original of his pl.3(2) fig.1 should be designated lectotype when found (see discussion in KENNEDY 1986c, p.36).

#### MATERIAL

SP unregistered, the original of SEUNES 1890b, pl.9,

fig.4, from "Tercis-Bédart", ex ARNAUD Collection, by the preservation from the Upper Maastrichtian *A. fresvillensis* Zone; MNHP 7188B, ex D'ORBIGNY Collection, from "Tercis".

#### DESCRIPTION

The larger specimen is a composite internal mould 122 mm long, deformed by post-mortem crushing such that the whorl section is a compressed oval. The umbilicus is broad and of moderate depth, with a rounded undercut wall. The expansion rate is low. Five primary ribs arise at the umbilical seam, sweep back across the umbilical wall, and strengthen into feeble bullae on the umbilical shoulder. These give rise to straight narrow, single, pro-radiate ribs that are strong to mid-flank, thereafter effacing, sweeping forwards and feebly convex on the outer flank and disappearing on the venter.

#### DISCUSSION

Evolute coiling, low expansion rate and presence of distant primary ribs only at a relatively small size immediately distinguish this species from all others from Landes before us, and show these specimens to be *Pachydiscus jacquoti jacquoti*. See KENNEDY (1986c) for a full discussion of this species. DE GROSSOUVRE (1894, pl.38, fig.38) illustrated a fine adult of this species from Angoumé under the name *Pachydiscus neubergicus*.

#### OCCURRENCE

The Tercis specimens are imprecisely localised, although preservation suggests the Upper Maastrichtian *A. fresvillensis* Zone. Elsewhere, the species ranges throughout the Upper Maastrichtian, with records from Bidart, Hendaye and the region between Gan and Rébénacq in Pyrénées-Atlantiques; the Calcaire à *Baculites* of the Cotentin Peninsula, Manche, France; Zumaya in northern Spain; Kunrade, The Netherlands; Armenia and Madagascar.

#### *Pachydiscus (Pachydiscus) armenicus*

ATABEKIAN & AKOPIAN, 1969

(Pl.13, Figs. 1,2)

- \*1969 *Pachydiscus gollevillensis armenicus* ATABEKIAN & AKOPIAN, p.8, pl.1, fig.2; pl.3, figs. 1,2.  
 1986c *Pachydiscus gollevillensis armenicus* Atabekian and Akopian - KENNEDY, p.34.  
 1987 *Pachydiscus gollevillensis armenicus* Atabekian and Akopian - KENNEDY, p.171.  
 in press *Pachydiscus (Pachydiscus) armenicus* Atabekian and Akopian - WARD & KENNEDY.

#### TYPE

Holotype is the original of ATABEKIAN & AKOPIAN, 1969, pl.3, fig.1, from the Upper Maastrichtian of the Azizbek region of Armenia.



## MATERIAL

SP unregistered, *ex* ARNAUD Collection, labelled "*Pachydiscus gollevillensis*, Tercis, La Pointe, P3 QR, Déterm. de Grossouvre"; by its preservation from the Upper Maastrichtian *A. fresvillensis* Zone.

## DESCRIPTION

The specimen is a crushed composite mould of a 90° whorl sector of a phragmocone with a maximum preserved whorl height of 34 mm. Coiling appears to have been moderately involute, with a small, shallow umbilicus, with a low wall and narrowly rounded umbilical shoulder. The whorl section is very compressed due to crushing, but the flanks appear to have been very broadly rounded, and the venter narrowly rounded. There are estimated 7 primary ribs on the fragment. They arise at the umbilical seam, and strengthen across the umbilical shoulder and inner flank, where they are feebly bullate, prorsiradiate and feebly concave. The primary ribs efface across the middle of the flanks, but ornament strengthens on the outermost flank and venter where 16 relatively coarse rounded ribs are preserved on the fragment. They strengthen across the ventrolateral shoulders, and are near-transverse across the venter.

## DISCUSSION

We have compared this fragment with a cast of the holotype of *Pachydiscus (P.) armenicus*, with which it agrees in the combination of numerous primary and secondary ribs. The present species has 16-20 bullae and 62-73 ribs per whorl, whereas in *Pachydiscus neubergicus neubergicus* the figures are 14-17 and 48-60. In *Pachydiscus gollevillensis* (D'ORBIGNY, 1850) [see revision in KENNEDY, 1986c, p.28, pls.1-3; pl.4, figs.4-6; pl.5, figs.12-14, 20-24; pl.11, figs. 1-5; text- figs. 2, 3p,r, 4c (with full synonymy)] there are only 9-11 bullae, but 80 ventral ribs.

## OCCURRENCE

*Pachydiscus armenicus* is an Upper Maastrichtian species, known from Armenia, Landes (the present record), Bidart, Hendaye, and the region between Gan and Rébénacq in Pyrénées - Atlantiques in France, as well as Zumaya in northern Spain.

*Pachydiscus (Pachydiscus) epiplectus*

(REDTENBACHER, 1873)

(Pl.11, Figs.1-4; Pl.14, Figs.1,5; Pl.15, Figs.13,14)

- \*1873 *Ammonites epiplectus* REDTENBACHER, p.121, pl.28, fig.1  
 1980 *Pachydiscus colligatus latiumbilicatus* BLASZKIEWICZ, p.46, pl.37, fig.3; pl.38, figs.1-4; pl.50, fig.1.  
 1986 *Pachydiscus (Pachydiscus) epiplectus* Redtenbacher, 1873 - KENNEDY & SUMMESBERGER, p.192, pl.6, figs.3,4; pl.7, figs.1,2; pl.9; pl.10,

figs.1-3; pl.11, figs.1-4; pl.12; pl.13, figs 1-3 (with full synonymy).

## TYPE

Lectotype, by the subsequent designation of KENNEDY & SUMMESBERGER 1986, p.192, is no. 1868.X.15 in the collections of the Geologisches Institut of Vienna University, from Muthmannsdorf in the Neue Welt Basin, Austria.

## MATERIAL

SP unregistered, *ex* ARNAUD Collection from the Carrière Duclerc, Arégave; SP unregistered, *ex* ARNAUD Collection, 2 specimens from the Grande Carrière, Angoumé; SP unregistered, *ex* ARNAUD Collection, from the Grande Carrière, Tercis; and OUM KZ 20321 from the Lower Maastrichtian *P. (P.) epiplectus* Zone Unit N3 at Tercis.

## DESCRIPTION

The SP specimen is a crushed half a whorl of a composite mould with a maximum preserved diameter of 115 mm and a maximum preserved whorl height of 52 mm. Coiling is very involute with a small umbilicus comprising an estimated 10% of the diameter. The umbilical wall is rounded, the umbilical shoulder more broadly so. Because of crushing it is not possible to reconstruct the original whorl section, although the inner flanks appear to have been somewhat flattened with broadly rounded ventrolateral shoulders and venter. Two distant, narrow, feeble primary ribs are present on the adapical part of the shell; the adapertural parts of the inner to middle flanks are smooth. The outermost flanks, ventrolateral shoulders and venter all bear coarse prorsiradiate ribs, concave on the ventrolateral shoulders, strong and feebly convex on the venter, where they are separated by wide interspaces. Eighteen ribs are preserved on the fragment.

The better preserved of the Angoumé specimens is shown as Pl.14, Figs.1,5. It is slightly distorted, with a maximum preserved diameter of 145 mm. Coiling is fairly involute, the umbilicus deep, with a broadly rounded umbilical wall; it comprises approximately 23% of the diameter. The whorls are slightly compressed, with a whorl breadth to height ratio of 0.94; the flanks are very broadly rounded, the ventrolateral shoulders and venter more narrowly so. The inner flanks are badly corroded, but umbilical bullae can be detected on the beginning of the last half whorl. Better preserved is a ventrolateral and ventral ornament of narrow ribs, concave on the ventrolateral shoulder and convex over the venter, where they number an estimated 50 on the last whorl. The larger Angoumé specimen is crushed and deformed into an ellipse with a major axis of 185 mm (Pl.15, Figs.13, 14). Ornament is well-preserved, with well-developed umbilical bullae giving rise to primary ribs that number 8-10 per half whorl. The ribs are narrow and prorsiradiate, and efface across the flanks before strengthening on the outermost flank and venter,

where they increase by intercalation. The largest Tercis specimen (ex ARNAUD Collection) is 180 mm in diameter.

#### DISCUSSION

The very feeble inner flank ornament and absence of spine bases show these fragments to be a *Pachydiscus* rather than an *Anapachydiscus* of the *fresvillensis* group. Differences from other species are discussed by KENNEDY & SUMMESBERGER (1986).

#### OCCURRENCE

Lower Maastrichtian of the Neue Welt Basin and Neuberg, Steiermark, in Austria. Landes (the present record); Hendaye and Bidart, Pyrénées-Atlantiques in France. The ex-USSR, Bulgaria and, possibly, Madagascar.

#### *Pachydiscus (Pachydiscus) perfidus*

DE GROSSOUVRE, 1894

(Pl.9, Figs.9,10; Pl.10, Figs.1,2,4,5; Pl.11, Figs.5,6; Pl.12, Figs.1-4,6; Pl.13, Figs.3,4)

1894 *Pachydiscus perfidus* DE GROSSOUVRE, p.213, pl.34, fig.1.

?1894 *Pachydiscus subrobustus* Seunes - DE GROSSOUVRE, p.200 (pars), pl.36, fig.2.

1984 *Pachydiscus (Pachydiscus) perfidus* De Grossouvre - KENNEDY & SUMMESBERGER, p.160, pl.3; pl.6, fig.6 (with full synonymy).

#### TYPE

Lectotype, by the subsequent designation of KENNEDY & SUMMESBERGER 1984, p.160, is the original of DE GROSSOUVRE 1894, pl.34, fig.1, SP unregistered, from Angoumé, (Pl.13, Figs.3,4).

#### MATERIAL

Numerous unregistered specimens in the SP and UPST collections, from Tercis and Angoumé. OUM KZ 16844, from the Upper Campanian *N. (N.) hyatti* Zone, Unit J, at Tercis.

#### DESCRIPTION

The lectotype is a crushed internal mould, distorted into an ellipse with a major diameter of 120 mm. Coiling is moderately involute, with the umbilicus comprising 26% of the diameter, shallow, with a low wall and broadly rounded umbilical shoulder. All other specimens are crushed to varying degrees, but the whorl section appears to have been compressed, with broadly rounded inner flanks, convergent outer flanks and a broadly rounded venter. Juveniles to a diameter of 100 mm are densely ribbed, with 18-20 feebly bullate primary ribs per whorl. These are straight, narrow and prorsiradiate on the inner and middle flanks, but flex forwards on the outermost flank and cross the venter in a shallow convexity. There are generally two intercala-

ted ribs between the primaries, arising below mid-flank. Beyond 100 mm diameter, ornament changes markedly, to predominantly long ribs which have well-developed umbilical bullae and strengthen markedly across the ventrolateral shoulders such that the venter is near-tabulate in costal section.

The best specimen seen is an incomplete adult 160 mm in diameter (Pl.11, Figs.5,6). Coiling is evolute, the umbilicus comprising 30% of the diameter, of moderate depth, with a flattened wall and broadly rounded umbilical shoulder. The whorl section has been modified by crushing, but appears to have originally been slightly compressed, with broadly rounded inner flanks, convergent outer flanks, and a broadly rounded venter. Thirteen or fourteen primary ribs are visible on the penultimate whorl. They are narrow, strong and distant, rursiradiate on the umbilical wall, and feebly concave and prorsiradiate on the inner flank. The badly crushed initial sector of the outer whorl show ribs branching from these primaries, with some shorter intercalated ribs. On the last half whorl there are 10 primary ribs, narrow, distant and markedly rursiradiate on the umbilical wall, concave on the inner flank, where they are incipiently bullate, straight and prorsiradiate on the inner and mid flank, then strengthening and projecting forwards in a shallow concavity across the ventrolateral shoulder to cross the venter in a broad, shallow convexity. There are one or two coarse, long or short intercalated ribs.

#### DISCUSSION

The juvenile referred to *Pachydiscus subrobustus* SEUNES by DE GROSSOUVRE (1894, pl.36, fig.2) may be better referred to *P. (P.) perfidus*. BLASZKIEWICZ (1980) and KENNEDY & SUMMESBERGER (1984) provide recent accounts of *P. (P.) perfidus* and discuss differences from others referred to the genus. The rapid change from juvenile to adult ornament, the latter with high compressed whorls and predominantly primary ribs with pronounced ventrolateral thickening is particularly distinctive.

#### OCCURRENCE

Upper Campanian *Nostoceras (N.) hyatti* Zone of Landes, France; the Vistula Valley, Poland; Gschlifgraben, Austria.

#### *Pachydiscus (Pachydiscus) subrobustus*

SEUNES, 1892

\*1892 *Pachydiscus subrobustus* SEUNES, p.15, pl.13(4), fig.1

1984 *Pachydiscus* cf. *subrobustus* Seunes, 1891 - KENNEDY & SUMMESBERGER, p.16, pl.8, fig.4 (with full synonymy).

#### TYPE

Lectotype, by the subsequent designation of KENNEDY

& SUMMESBERGER, 1984, p.161, is the original of SEUNES 1892, pl.13(4), fig.1, from Tercis, Landes, France, ex ARNAUD Collection. The specimen was formerly in the SP collections, but we were unable to locate it during a recent visit (1992).

#### DISCUSSION

*Pachydiscus (P.) subrobustus* is a poorly known species. It shows similarities to *Pachydiscus (P.) perfidus*, described above, which has coarser ribs with pronounced ventrolateral thickenings when adult. A possible juvenile is shown as Pl.3, Figs.2,3.

#### OCCURRENCE

Upper Campanian of Landes, France; Gschliefgraben, Austria; Poland, and the Ukraine (Donbass region).

#### *Pachydiscus (Pachydiscus) cf. colligatus* (BINKHORST, 1861)

compare:

- 1861 *Ammonites colligatus* BINKHORST, p.25 (*pars*), pl.8 only.  
 1986a *Pachydiscus (Pachydiscus) colligatus* (Binkhorst, 1861) - KENNEDY, p.36, text-figs.13,14.  
 1987 *Pachydiscus (Pachydiscus) colligatus* (Binkhorst, 1861) - KENNEDY, p.162, pl.1, figs.1,2; pl.2, figs.1,2; pl.3; pl.4, figs.4,5 (with full synonymy).

#### TYPE

Lectotype, by the subsequent designation of KENNEDY, 1987, p.162, is an unregistered specimen in the collections of the Museum für Naturkunde, Berlin, the original of BINKHORST 1861, pl.8, from the Upper Campanian of Jauche, Brabant, Belgium.

#### MATERIAL

Several unregistered specimens in the SP and UPST collections, from Tercis and Angoumé, by their preservation from the Upper Campanian Tercis Pale Flint Member. OUM KZ 16833, 16834 and KZ 16836, from the upper part of Unit G at Tercis.

#### DISCUSSION

These poorly preserved specimens of a large (septate to 180 mm) massive-whorled *Pachydiscus*, densely ribbed when juvenile, but losing all but the ventral ribbing in middle and later growth, belong to the group of *Pachydiscus (P.) colligatus*, but are too poorly preserved for firm assignment to the species.

#### OCCURRENCE

As for material.

Suborder **Ancyloceratina** WIEDMANN, 1966  
 Superfamily TURRILITACEAE GILL, 1871  
 Family NOSTOCERATIDAE HYATT, 1894  
 Genus and subgenus *Nostoceras* HYATT, 1894

#### TYPE SPECIES

*Nostoceras stantoni* HYATT, 1894, p.569; = *Nostoceras? approximans* CONRAD, 1855, p.266; by original designation.

*Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941  
 (Pl.9, Figs.1,4; Pl.14, Figs.2-4; Pl.16, Figs.2,3;  
 Pl.17, Figs.10,11; Pl.18, Figs.2-4,6,7; Pl.19,  
 Figs.1-4,8-10).

- \*1941 *Nostoceras hyatti* STEPHENSON, p.410, pl.81, figs.9-12.  
 1974 *Nostoceras hyatti* Stephenson - COBBAN, p.10, pl.5, figs.1-21; pl.6, figs.1-12; pl.7, figs.1-10; pl.8, figs.1-30; text-fig 8 (with full synonymy).  
 1980 *Nostoceras pozaryskii* BLASZKIEWICZ, p.26 (*pars*), pl.10, figs.8,9,12.  
 1986a *Nostoceras (Nostoceras) hyatti* Stephenson 1941 - KENNEDY, p.90, pl.20, figs.7-9.  
 1986a *Nostoceras (Nostoceras) pozaryskii* Blaszkiewicz - KENNEDY, p.92, text-fig.31A.  
 in press *Nostoceras (Nostoceras) hyatti* Stephenson, 1941; WARD & KENNEDY.  
 in press *Nostoceras (Nostoceras) hyatti* Stephenson, 1941; KENNEDY & COBBAN.

#### TYPES

Holotype is USNM 77258, the original of STEPHENSON 1941, pl.81, fig.9, from the Upper Campanian *N. (N.) hyatti* Zone Nacatoch Sand on Postoak Creek on the north edge of Corsicana, Navarro County, Texas. There are four paratypes.

#### MATERIAL

Numerous unregistered specimens in the SP and UPST collections, from Angoumé and Tercis, and by their preservation from the Upper Campanian *N. (N.) hyatti* Zone Tercis Marly and Pale Flint Members. EMP unregistered from Tercis. OUM KZ 16835, from the top quarter of Unit G at Tercis Quarry, Tercis Marly Member, *N. (N.) hyatti* Zone.

#### DESCRIPTION

The shell consists of an initial helix with an apical angle of less than 90° and the whorls in close contact. Ornament is of narrow ribs, straight and prosiradiate on the outer whorl face, where they link in pairs to rather coarse tubercles at mid-face, and intercalate between. A second row of tubercles lies just above the contact with the succeeding whorl in some specimens.

Body chambers referred to the species fall into two size classes, interpreted as microconchs (Pl.19, Figs.1-4,10) and macroconchs (Pl.9, Figs.1,4; Pl.17,

Figs.10,11; Pl.18, Figs.4,5,7,8; Pl.19, Figs.8,9). The initial part, joining the spire to the U shaped body chamber, has irregular bituberculate ribbing that may be annular, looped or zig-zag. On the final sector of body chamber ribs become even, simple, and coarse on the sides, with well-developed tubercles. Ribs may loop or zig-zag between tubercles on the adapical parts of the body chamber, but become simple and annular on the final shaft.

#### DISCUSSION

*Nostoceras (N.) hyatti* was revised at length by COBBAN (1974) and KENNEDY & COBBAN (in press). It has a much smaller apical angle to the spire than *N. (N.) helicinum* (SHUMARD, 1861) (p.191; see COBBAN, 1974, p.8, pl.4, figs.1-21; text-fig 6), although fragments may be difficult to distinguish, while the body chamber has coarser, simpler ribbing, rather than the complex pattern of looped and intercalated ribs shown on *N. (N.) helicinum*.

*Nostoceras (N.) pozaryskii* BLAZSKIEWICZ, 1980 (p.26, pl.10, figs.1-5, 8,9,11-15) is in part based on *N. (N.) hyatti*, including the original of his pl.10, figs.8,9,12, (re-illustrated here as Pl.16, Figs.2,3), although the holotype of *N. (N.) pozaryskii* is a *N. (N.) helicinum* (BLAZSKIEWICZ, 1980, pl.10, figs.1-5; see Pl.16, Figs.7-9). The specimen from the so-called Maastichtian of Maurens in the Dordogne (KENNEDY, 1986a. pl.20 figs.7-9) is also a *N. (N.) hyatti*.

#### OCCURRENCE

Upper Campanian *N. (N.) hyatti* Zone of Tercis, Landes; Maurens, Dordogne, France; Zumaya, Spain; the Mons Basin, Belgium; Vistula Valley, Poland; New Jersey, Mississippi, Texas and Colorado (Huerfano County) in the USA; Angola, Madagascar and Israel.

#### *Nostoceras (Nostoceras) helicinum*

(SHUMARD, 1861)

(Pl.16, Figs.1,4-9; Pl.17, Figs.5-8; Pl.18, Figs.1,6;  
Pl.19, Figs.5-7)

- \*1861 *Turrilites helicinus* SHUMARD, p.191.  
1974 *Nostoceras helicinum* (Shumard) - COBBAN, p.8, pl.4, figs.1-21; text-fig.6 (with synonymy).  
1980 *Nostoceras pozaryskii* BLAZSKIEWICZ, p.26 (pars), pl.10, figs.1-7,11,13,15 only.  
in press *Nostoceras (Nostoceras) helicinum* (Shumard, 1861) - KENNEDY & COBBAN.

#### TYPES

SHUMARD's types, from Chatfield Point and Corsicana in Navarro County, Texas, are lost. STEPHENSON (1941, p.411, pl.80, fig.11) designated USNM 21103a, from the Upper Campanian *N. (N.) hyatti* Zone Nacatoch Sand near Chatfield, Navarro County, Texas, neotype of the species.

#### MATERIAL

OUM KZ 16848, from the Upper Campanian *N. (N.) hyatti* Zone, Tercis Pale Flint Member, Unit J; OUM KZ 16834 from the Tercis Marly Member, top quarter of Unit G at Tercis; and numerous uncatalogued specimens in the SP and UPST Collections.

#### DESCRIPTION

The helix of OUM KZ 16848 (Pl.18, Fig.6; Pl.19, Figs.5-7) is badly crushed and incomplete, showing only delicate ribbing and no tubercles, although this is probably a result of defective preservation. The loosely coiled section of the spire and adapical part of the body chamber are ornamented by crowded ribs. Some arise from feeble bullae on the flanks, some do not; they are straight and prorsiradiate, commonly bifurcating on the ventrolateral shoulder and zig-zagging and looping irregularly across the venter. There are no tubercles at this stage. Massive ventral tubercles appear on the curved sector of the body chamber and link groups of two flank ribs, with up to three looped ribs connecting the tubercles across the venter.

Ribbing coarsens somewhat on the final shaft, becoming simple and annular, without tubercles.

#### DISCUSSION

Helices of *Nostoceras (N.) helicinum* (SHUMARD, 1861, p.191; COBBAN, 1974, p.8, pl.4, figs.1-21; text-fig.6) may be differentiated from those of *N. (N.) approximans* (CONRAD, 1855) (p.266) and *N. (N.) hyatti* STEPHENSON, 1941 (p.410, pl.81, figs.9-12; COBBAN 1974, p.10, pl.5, figs.1-21; pl.6, figs.1-12; pl.7, figs.1-10; pl.8, figs.1-30; text-fig.8) in their much lower apical angle. The ornament is finer than that of *N. (N.) hyatti*, but coarser than that of *N. (N.) approximans*. Body chambers are easily distinguished. *Nostoceras (N.) helicinum* is a larger species than *N. (N.) approximans*, has much coarser tubercles on the hook, bullae on the sides and many and complexly looped and intercalated ribs, compared to the small tubercles and simple ribs of *N. approximans*. From *N. (N.) hyatti* body chambers of *N. (N.) helicinum* may be distinguished by their much finer ribbing, bullae on the flanks, and complex pattern of looped and intercalated ribs as opposed to the very coarse simple ribbing of *N. (N.) hyatti*. *Nostoceras (N.) helicinum humile* STEPHENSON, 1941 (p.412, pl.81, figs.4-6) differs from the typical form in its slender whorl and tubercles in the upper row, larger than in the lower. *Nostoceras helicinum crassum* STEPHENSON, 1941 (p.412, pl.81, figs.7,8) has coarse ribs like *N. (N.) hyatti*, but the low spire typical of *N. (N.) approximans*. The holotype of *N. (N.) pozaryskii* BLAZSKIEWICZ, 1980, and several other figured specimens (pl.10, figs.1-7, 11,13,15) are *N. (N.) helicinum*, as can be seen from Pl.16, Figs.4-9.

#### OCCURRENCE

Upper Campanian *Nostoceras (N.) hyatti* Zone of Tercis, Landes, France; the Vistula Valley, Poland; New

Jersey, Arkansas, Tennessee, Mississippi and Texas in the USA; Israel. An allied form occurs in Angola. Record from Colombia (BÜRGL & DUMIT TOBON, 1954, pl.6) belongs to some other species.

Genus *Didymoceras* HYATT, 1894

TYPE SPECIES

*Ancyloceras nebrascense* MEEK & HAYDEN, 1856, p.71 by original designation of HYATT (1894, p.573).

*Didymoceras* sp. nov.  
(Pl.20, Fig.15)

1963 *Bostrychoceras secoense* YOUNG, p.42 (*pars*), pl.4, fig.8 only.

1980 *Didymoceras* cf. *secoense* Young - BLASZKIEWICZ, p.24, pl.5, figs.4,6; pl.7, figs.16,19.

MATERIAL

An unregistered specimen in the Sorbonne Collections, labelled "*Heteroceras polyplacum*, Tercis, Grand Carrière, Q".

DESCRIPTION

The specimen is a composite internal mould of the last two whorls of a loosely coiled helix and the initial, uncoiling section of the body chamber. The helical whorls are barely in contact, and have a rounded, sub-circular whorl section. Ribs are strong on the upper whorl face, and most are single. They strengthen across the juncture of upper and outer whorl faces (where they may branch) and are feebly concave. They are straight and feebly prorsiradiate on the outer whorl face. One rib, rarely two ribs, link to a strong, transversely elongated tubercle situated approximately at mid-flank, while non-tuberculate ribs intercalate between and extend to the juncture of outer and lower whorl faces. These ribs, and those with tubercles may link to a second row of tubercles at the juncture of outer and lower whorl faces. All ribs are strong, coarse and rectiradiate on the lower whorl face. There are periodic constrictions, and occasional ribs are feebly flared.

DISCUSSION

One of YOUNG's specimens of *Bostrychoceras secoense* (1963, pl.4, fig.8) belongs to this undescribed species of *Didymoceras*; the holotype and other specimens referred to *B. secoense* by YOUNG are *Bostrychoceras polyplacum* (ROEMER, 1841). Fragments referred to as *Didymoceras* cf. *secoense* by BLASZKIEWICZ (1980, p.24, pl.5, figs.4,6; pl.7, figs.16,19) belong here.

OCCURRENCE

Upper Campanian, Tercis, Landes, France; Vistula Valley, Poland; Bergstrom Formation of Travis County, Texas; Wenonah Formation of New Jersey and Pierre

Shale of the US Western Interior (KENNEDY & COBAN, personal observations).

Family DIPLOMOCERATIDAE SPATH, 1926  
Subfamily DIPLOMOCERATINAE SPATH, 1926  
Genus *Glyptoxoceras* SPATH, 1925

TYPE SPECIES

*Hamites rugatus* FORBES, 1846, p.116, pl.11, fig.6, by original designation of SPATH, 1925, p.30, as *Hamites (Anisoceras) rugatus* (FORBES) KOSSMAT.

*Glyptoxoceras* cf. *rugatus* FORBES, 1846  
(Pl.15, Figs.1-12; Pl.17, Fig.9; Pl.20, Figs.5-8,12,13)

MATERIAL

A series of unregistered specimens in the SP Collection, ex ARNAUD Collection, labelled "Tercis, La Pointe, P3", and presumed to be from the *A. fresvillensis* Zone.

DESCRIPTION

These fragments have whorl heights of up to 20 mm, and are up to 50 mm long, with rib indices of 6-9.

Genus *Diplomoceras* HYATT 1900

TYPE SPECIES

*Baculites cylindracea* DEFRANCE, 1816, p.160, by original designation of HYATT, 1900, p.571

*Diplomoceras cylindraceum* (DEFRANCE, 1816)  
(Pl.15, Fig.15; Pl.17, Figs.1-4)

\*1816 *Baculites cylindracea* DEFRANCE, p.160.

1992 *Diplomoceras cylindraceum* (Defrance, 1816) - HENDERSON, *et al.*, p. 140, figs. 5, 6a-e, h-k, 7.

1992b *Diplomoceras cylindraceum* (Defrance, 1816) - KENNEDY & HENDERSON, p.704, pl.6, figs.1-3; text-figs. 1B,3.

TYPE

Neotype, designated by KENNEDY, 1987, p.183, is IRSNB 10511, from the Upper Maastrichtian Meerssen Chalk of St. Pietersberg, Maastricht, the Netherlands.

MATERIAL

Two small fragments, SP unregistered, ex ARNAUD Collection, labelled "*Heteroceras*, Tercis, La Pointe", and inferred to be from the *A. fresvillensis* Zone. More complete is SP unregistered ex ARNAUD Collection, labelled "*Hamites - Heteroceras* Tercis-Gde Carrière, Danien-Garumnien Sup. W".

DESCRIPTION

The specimens are all crushed. The two smaller frag-

ments have whorl heights of 13.5 and 23.5 mm (Pl.15, Fig.15; Pl.17, Figs.2-4), and rib indices of 8 and 12. The ribs are narrow, sharp, annular, effaced on the dorsum, straight and prorsiradiate on the flanks, strengthening on the outer flank and venter, where they are transverse. The largest specimen (Pl.17, Fig.1) consists of a curved sector with a maximum preserved whorl height of 35 mm and a rib index of 14. Traces of two subparallel shafts survive as composite external moulds.

#### DISCUSSION

High rib index and coiling show these fragments to be *Diplomoceras cylindraceum*. The species is fully discussed by KENNEDY (1986c,1987), KENNEDY & HENDERSON (1992b) and HENDERSON *et al.* (1992) who provide full synonymies.

#### OCCURRENCE

*Diplomoceras cylindraceum* ranges throughout the whole of the Maastrichtian, and may appear in the Upper Campanian. The geographic range is considerable: northern and south-west France, northern Spain, Italy, the Mons Basin, Belgium, the Netherlands, Denmark, Poland, Austria, The Ukraine, Bulgaria, South Africa, Madagascar, south India, Western Australia, the Antarctic Peninsula, Chile, Argentina, Brazil, California, Alaska (USA), British Columbia (Canada), Japan, and, perhaps, Greenland and New Zealand.

Family BACULITIDAE GILL, 1871

Genus *Baculites* LAMARCK, 1799

#### TYPE SPECIES

*Baculites vertebralis* LAMARCK, 1801, p.103, by the subsequent designation of MEEK, 1876, p.391.

*Baculites leopoliensis* NOWAK, 1908  
(Pl.20, Figs.9-11,14,16-19)

\*1908 *Baculites anceps* LAM, sp. em. NOWAK 1. varietas *leopoliensis* NOWAK, p.328 (*pars*), pl.14, fig.1-5,10?,11; text-figs.1-5 on p.329;? text-figs.5-10 on p.331.

non 1951 *Baculites anceps* var. *leopoliensis* Nowak - MICHAÏLOV, p.46, pl.3, fig.15.

non 1964 *Baculites anceps leopoliensis* Nowak, 1908 - TZANKOV, p.149, pl.10, fig.2.

non 1974 *Baculites anceps leopoliensis* Nowak - NAIDIN & SHIMANSKY, p.164, pl.53, fig.5.

non 1976 *Baculites anceps leopoliensis* Nowak - ATABEKIAN & KHAKHIMOV, p.96, pl.11, figs.11-13.

1986a *Baculites leopoliensis* Nowak, 1908 - KENNEDY, p.114, pl.18, figs.1,4-12.

1986b *Baculites leopoliensis* Nowak, 1908 - KENNEDY, p.1013, pl.2, figs.1,2,11,12; pl.3, figs.22-24.

#### TYPE

Lectotype, by the subsequent designation of KENNEDY, 1986b, p.1013, is the original of NOWAK, 1908, pl.14, fig.1, from Lipniki, formerly in Galicia, Poland, but now in The Ukraine.

#### MATERIAL

Numerous unregistered specimens from Angoumé and Tercis in the SP and UPST collections. OUM KZ 16839, Tercis Marly Member from the top m of unit H; OUM KZ 16846-7 from unit J; OUM KZ 16850, 16855, 16856, 16857, 16858, 16861 from the upper part of unit K (Tercis Pale Flint Member) and OUM KZ 20324 and 20326, from Unit N2 in Tercis Quarry; all Upper Campanian *N. (N.) hyatti* Zone.

#### DESCRIPTION

Specimens are all crushed composite moulds of both phragmocone and body chamber, with maximum preserved whorl heights of up to 35 mm. The whorl section appears to have been compressed, with a broadly rounded to flattened dorsum, feebly convex dorsal flanks, convergent ventral flanks and a narrowly rounded venter. There are up to 3 or 4 ribs in a distance equal to the whorl height. They are weak and feebly convex on the dorsum, but strengthen across the dorsolateral region and are broad, coarse, concave and transverse on the dorsal two thirds of the flank. They project strongly forwards and weaken markedly on the ventral third of the flanks, where additional riblets and striae intercalate, all elements of ornament intersecting the line of the venter at an acute angle, and crossing the venter in a narrow convexity.

#### DISCUSSION

Even transverse crescentic ribs and intercalated riblets and striae on the ventral third of the flanks distinguish *Baculites leopoliensis* from other European Campanian-Maastrichtian species, as discussed by KENNEDY (1986a,b), to whom reference should be made. NOWAK (1908) regarded this species as Maastrichtian, but we visited a number of Campanian and Maastrichtian localities in Poland in 1990, where we found the species to be common in the upper Campanian *Nostoceras (N.) hyatti* [*pozaryskij*] Zone and to be absent in the succeeding Maastrichtian.

#### OCCURRENCE

Upper Campanian of The Ukraine, Vistula Valley, Poland, the Petites-Pyrénées, Landes and Dordogne (the environs of Maurens) in France.

Superfamily SCAPHITACEAE GILL, 1871

Family SCAPHITIDAE GILL, 1871

Subfamily SCAPHITINAE GILL, 1871

Genus *Hoploscaphites* NOWAK, 1911

## TYPE SPECIES

*Ammonites constrictus* J. SOWERBY, 1817, p.189, pl.A, fig.1, by original designation of NOWAK, 1911, p.565.

*Hoploscaphites constrictus* (J. SOWERBY, 1817)  
(Pl.20, Figs.1-4)

- \*1817 *Ammonites constrictus* J. SOWERBY, p.189, pl.A, fig.1.  
 1908 *Scaphites* cf. *spiniger* Schlüt. - DE GROSSOUVRE, p.38, pl.10, fig.6.  
 1908 *Scaphites* cf. *monasterensis* Schlüt - DE GROSSOUVRE, p.38, pl.11, fig.8.  
 1986b *Hoploscaphites constrictus* (J. Sowerby, 1817) - KENNEDY, p.1019, pl.3, figs.1,9-12; pl.4, figs.1-19; pl.5, figs.1-17, 24-26.  
 1986c *Hoploscaphites constrictus* (J. Sowerby, 1817) - KENNEDY, p.64, pl.13, figs.1-13, 16-24; pl.14, figs.1-38; pl.15, figs.1-31; text-figs.9,11a-h (with full synonymy).  
 1986d *Hoploscaphites constrictus* (J. Sowerby, 1817) - KENNEDY, figs.10g,h,k,l.  
 1987 *Hoploscaphites constrictus* (J. Sowerby, 1817) - KENNEDY, p.197, pl.31, figs.1,8-26; pl.32, figs.1-12, 18-21 (with full synonymy).  
 1987 *Hoploscaphites constrictus* (J. Sowerby) - KENNEDY & SUMMESBERGER, p.34, pl.6, figs.6-24.  
 1987 *Hoploscaphites constrictus* (Sowerby, 1818) - VAN DER TUUK, p.64.  
 1987 *Hoploscaphites constrictus constrictus* (Sowerby, 1818) - VAN DER TUUK, p.76, figs.5,6,7,11, 20a-c,21a-c,23a-c.  
 1987 *Hoploscaphites constrictus niedzwiedzki* (Uhlig, 1894) VAN DER TUUK, p.76, figs.9,10,24a-c.  
 1987 *Hoploscaphites constrictus* ssp. undet; VAN DER TUUK, p.77, figs.8,25.  
 1987 *Hoploscaphites* sp. VAN DER TUUK, p.77, figs.4,17a-c.  
 1987 *Hoploscaphites constrictus* (J. Sowerby, 1817) - JAGT, p.1, figs.1-6.  
 1988 *Hoploscaphites constrictus* (J. Sowerby, 1817) - MACHALSKI and WALASZCZYK, p.67, figs.2a,b.  
 1989 *Hoploscaphites constrictus* (J. Sowerby, 1817) - KENNEDY, figs.9a-9n.

## TYPES

Lectotype, by the subsequent designation of KENNEDY, 1986c, p.68, is no C36733 in the collections of the Natural History Museum, London, the original of J. SOWERBY, 1817, pl.A, fig.1; paralectotypes are C70645-C70647, all from the Upper Maastrichtian Calcaire à *Baculites* of the Cotentin Peninsula, Manche, France.

## MATERIAL

OUM KZ 16863 and KZ 16867, from the Tercis Dark Flint Member, Unit N3, and OUM KZ 20322 from the basal marl of Unit N3 at Tercis. OUM KZ 16919 is

imprecisely localised but, by its preservation, came from a slightly higher horizon. There are a number of unregistered specimens in the SP and UPST Collections.

## DESCRIPTION

OUM KZ 1863 is a macroconch phragmocone 27 mm in diameter, and part of the shaft of the body chamber with a maximum preserved whorl height of 21 mm. Coiling of the phragmocone is very involute, with a tiny, deep umbilicus. The inner flanks are ornamented by narrow, straight, primary ribs that increase by branching and intercalation on the middle and outer flank and pass straight across the venter. Delicate ventrolateral tubercles become conspicuous towards the end of the outer whorl. The body chamber is high-whorled, with a straight to feebly convex umbilical wall that conceals part of the umbilicus of the phragmocone. Four progressively coarsening umbilicolateral bullae are preserved. They give rise to low, broad, prorsiradiate ribs, either singly or in pairs, which flex back on the outer flank, where they increase by branching and intercalation, terminating in ventrolateral tubercles. These are small and conical at the beginning of the body chamber, but coarsen and become clavate adaperturally. They are linked across the venter by groups of two or three delicate riblets, with others intercalating between. OUM KZ 16919 is a smaller macroconch with a coarser ribbed phragmocone. OUM KZ 16867 preserves the adapertural end of a macroconch body chamber.

## DISCUSSION

The present specimens compare well with macroconchs from the Lower Maastrichtian of Hemmoor, Niederelbe, north-west Germany (BIRKELUND, 1982, p.19, pl.3, figs.1-14). There are a number of recent discussions of *H. constrictus*, including reillustration of the type material from the Calcaire à *Baculites* of Manche, France (KENNEDY, 1986c), Petites-Pyrénées (KENNEDY, 1986b), environs of Maastricht (KENNEDY, 1987; VAN DER TUUK, 1987; JAGT, 1987), Neuberg, Steiermark, Austria (KENNEDY & SUMMESBERGER, 1986) and Nagoryany in The Ukraine (KENNEDY & SUMMESBERGER, 1987).

We see no reason to vary conclusions reached previously (1986c) that the lectotype of *H. constrictus* is a macroconch, and that the form described as *Scaphites niedzwiedzki* UHLIG 1894 (p.220, fig.2) is the microconch of *H. constrictus*, and see no support whatsoever for the views of VAN DER TUUK (1987) that they represent subspecies in which both macro- and microconchs occur. Equally we believe it more rational to treat *H. tenuistriatus* (KNER, 1848) (see revision in KENNEDY, 1987) as a distinct short-lived species rather than a subspecies of *H. constrictus*. The *Hoploscaphites* sp. of VAN DER TUUK (1987, p.77, figs.4,17a,b) with siphonal tubercles from the Upper Maastrichtian of Limburg, the Netherlands, was thought by that author to be possibly transitional between *Hoploscaphites* and *Acanthoscapites*. It seems to be no more than a malformed *H.*



*constrictus* and even if this were not the case, could hardly be transitional between these genera, as *Acanthoscaphites* appears at the bottom of the Maastrichtian.

#### OCCURRENCE

*Hoploscaphites constrictus* ranges through almost the whole of the Maastrichtian. At Kronsmoor in north Germany, the first specimen appears 3.5 to 5.0 m above the base of the *Belemnella lanceolata* Zone, while in Denmark it is common in the topmost hardground of the Maastrichtian White Chalk that is immediately overlain by the Palaeocene Fish Clay. It is known from the Biscay region of France and Spain, Petites Pyrénées (Haute Garonne), Tercis (Landes) and the Calcaire à *Baculites* of the Cotentin Peninsula (Manche) France; the Nekum and Meerssen Chalks of the Maastricht region in Belgium and the Netherlands; Germany, Denmark, southern Sweden, Poland, Austria (Steiermark),

Czechoslovakia, Bulgaria, and the ex- USSR region (Donbass, Carpathians, Transcaspia, Kopet Dag).

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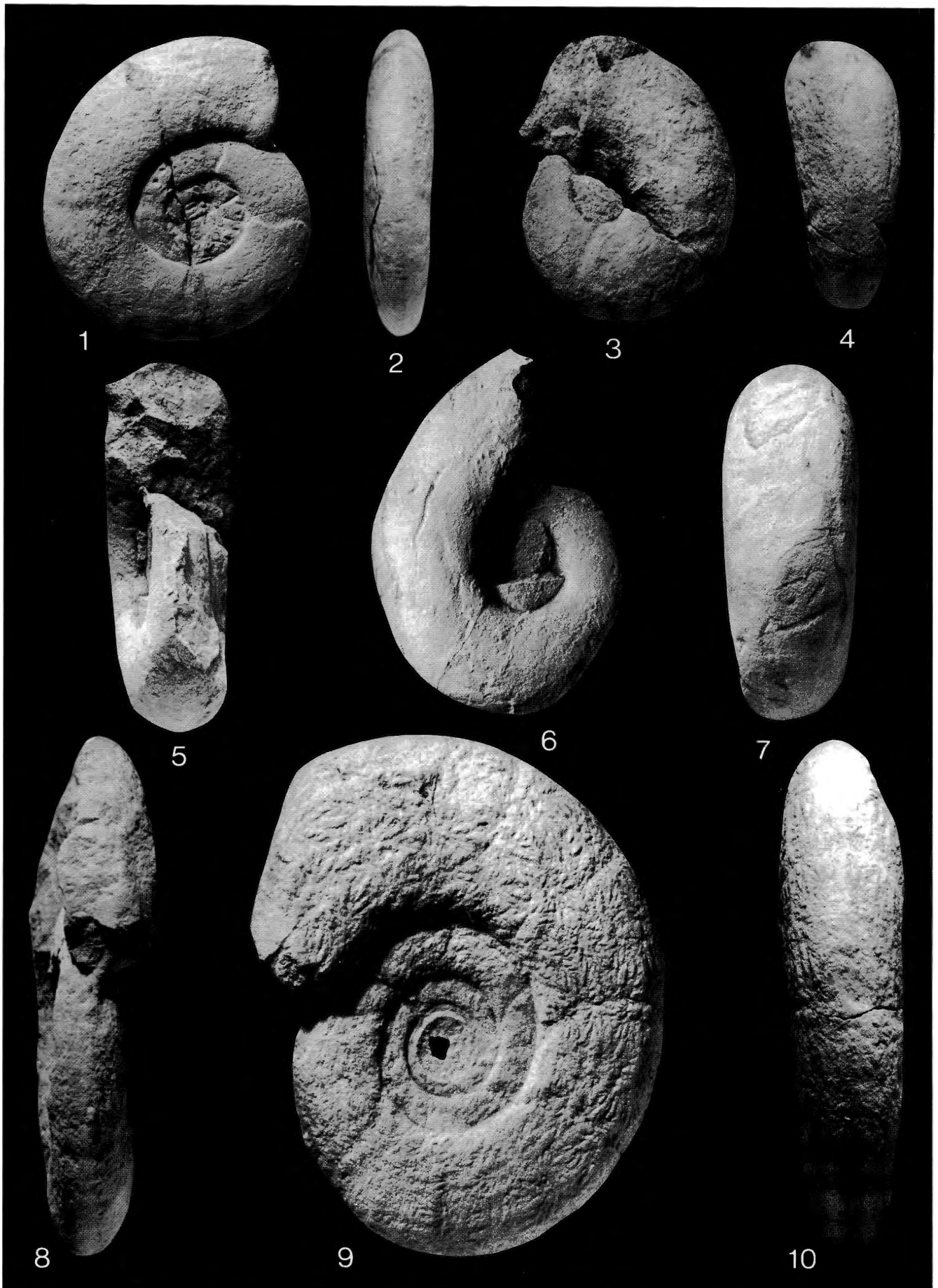
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## PLATE 1

Figs. 1, 2 — *Hauericeras fayoli* DE GROSSOUVRE, 1894, the holotype, SP unregistered, ex ARNAUD Collection, said to be from Assise Q at Montmoreau (Charente), but by its preservation from Tercis.

Figs. 3, 4 — *Pseudophyllites indra* (FORBES, 1846), MNHP 7192 (ex D'ORBIGNY Collection), from Tercis.

Figs. 5-7 — *Saghalinites wrighti* BIRKELUND, 1965, SP unregistered, ex ARNAUD Collection, labelled "*Gaudryceras planorbiforme* Tercis-QR", Tercis, banc à *Echinocorys conoidea* P3. Détermination de Grossouvre".

Figs. 8-10 — *Anagaudryceras lueneburgense* (SCHLÜTER, 1872), MNHP 2001.227 (ex DE GROSSOUVRE Collection), from Tercis.

All figures are x 1

## PLATE 2

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Figs. 1-3, 10, 11, 14 — *Desmophyllites larteti* (SEUNES, 1892).  
 1-3, SP unregistered, ex ARNAUD Collection labelled "*Schluteria larteti* de Gross. Angoumé.  
 10, 11, SP unregistered, ex ARNAUD Collection labelled "*Ammonites* n. sp., Tercis, La Pointe".  
 14, SP unregistered, ex ARNAUD Collection, labelled "*Schluteria larteti* de Grossouvre. Angoumé, P3.

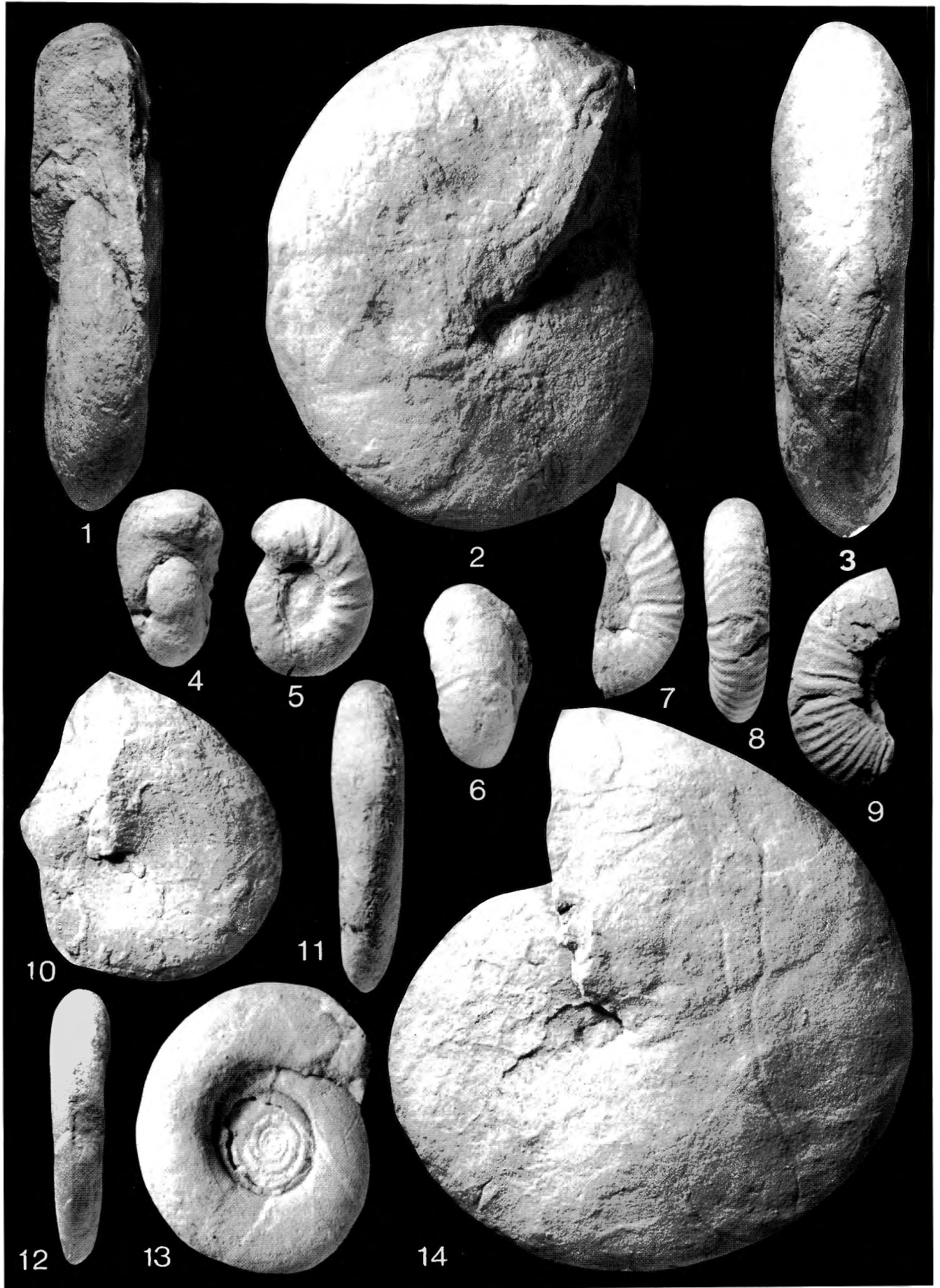
Figs. 4-6 — *Pseudokossmaticeras brandti* (REDTENBACHER, 1873). SP unregistered, ex ARNAUD Collection: a juvenile associated with material from Angoumé.

Figs. 7-9 — *Pseudokossmaticeras duereri* (REDTENBACHER, 1873). SP unregistered, ex ARNAUD Collection, labelled "Tercis, Gde. Carrière, P3".

Figs. 12, 13 — *Anagaudryceras lueneburgense* (SCHLÜTER, 1872). SP unregistered, ex ARNAUD Collection, the original of *Gaudryceras planorbiforme* J. BÖHM of DE GROSSOUVRE, 1894, pl.27, fig.2, from the "Grande Carrière de Tercis".

All figures are x 1







## PLATE 3

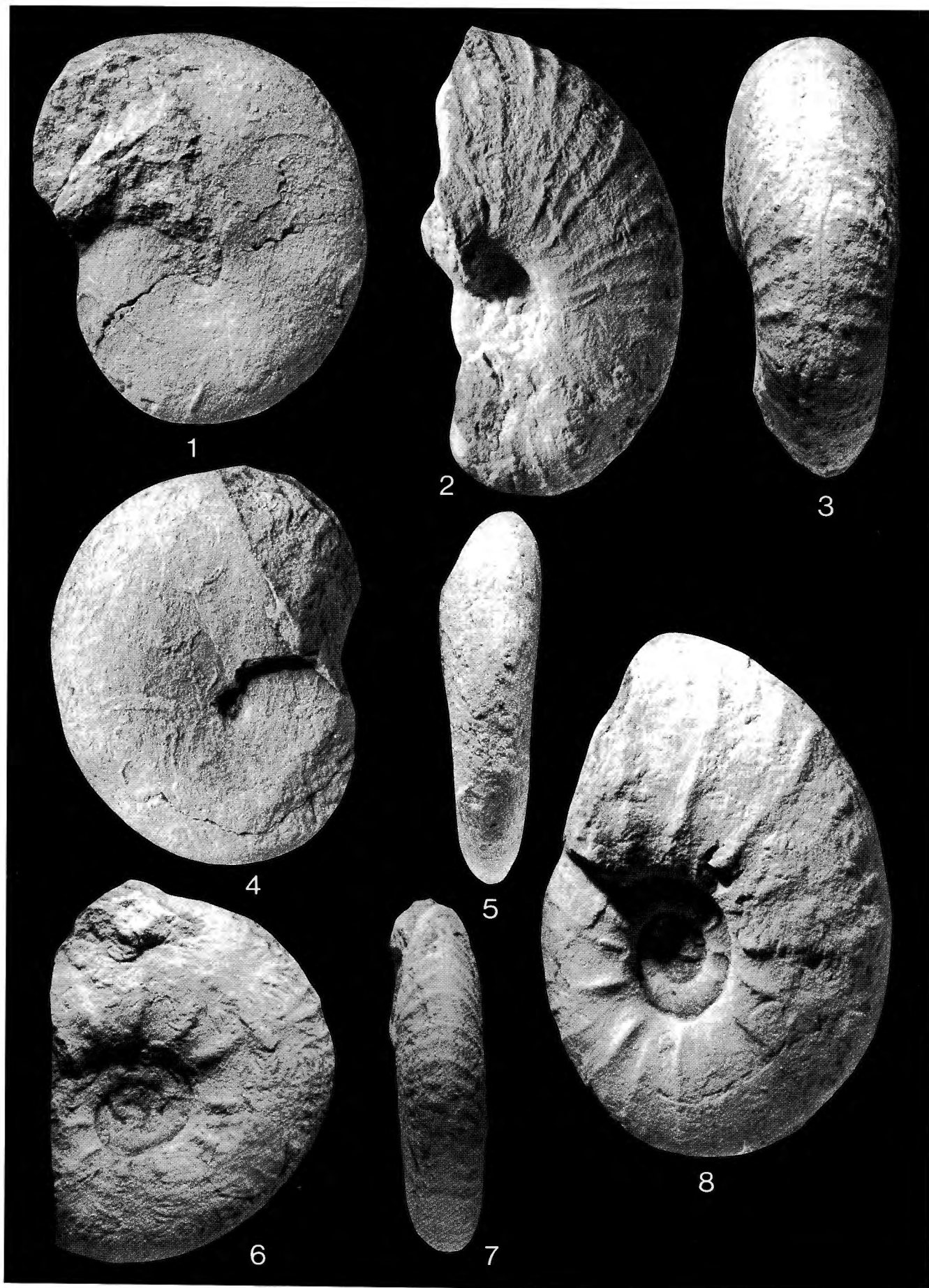
Figs. 1, 4, 5 — *Desmophyllites larteti* (SEUNES, 1892), SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus larteti* Seunes, Angoumé, niveau de la Pointe. Détermination de Grossouvre, PQR”.

Figs. 2, 3 — *Pachydiscus (Pachydiscus) cf. subrobustus* SEUNES, 1892, MNHP unregistered, from Tercis.

Figs. 6, 7 — *Pachydiscus (Pachydiscus) neubergicus neubergicus* (VON HAUER, 1856), MNHP 7188b (ex D’ORBIGNY Collection), from Tercis.

Fig. 8 — *Pachydiscus (Pachydiscus) jacquoti jacquoti* (SEUNES, 1890a), MNHP 7188b (ex D’ORBIGNY Collection), from Tercis.

All figures are x 1



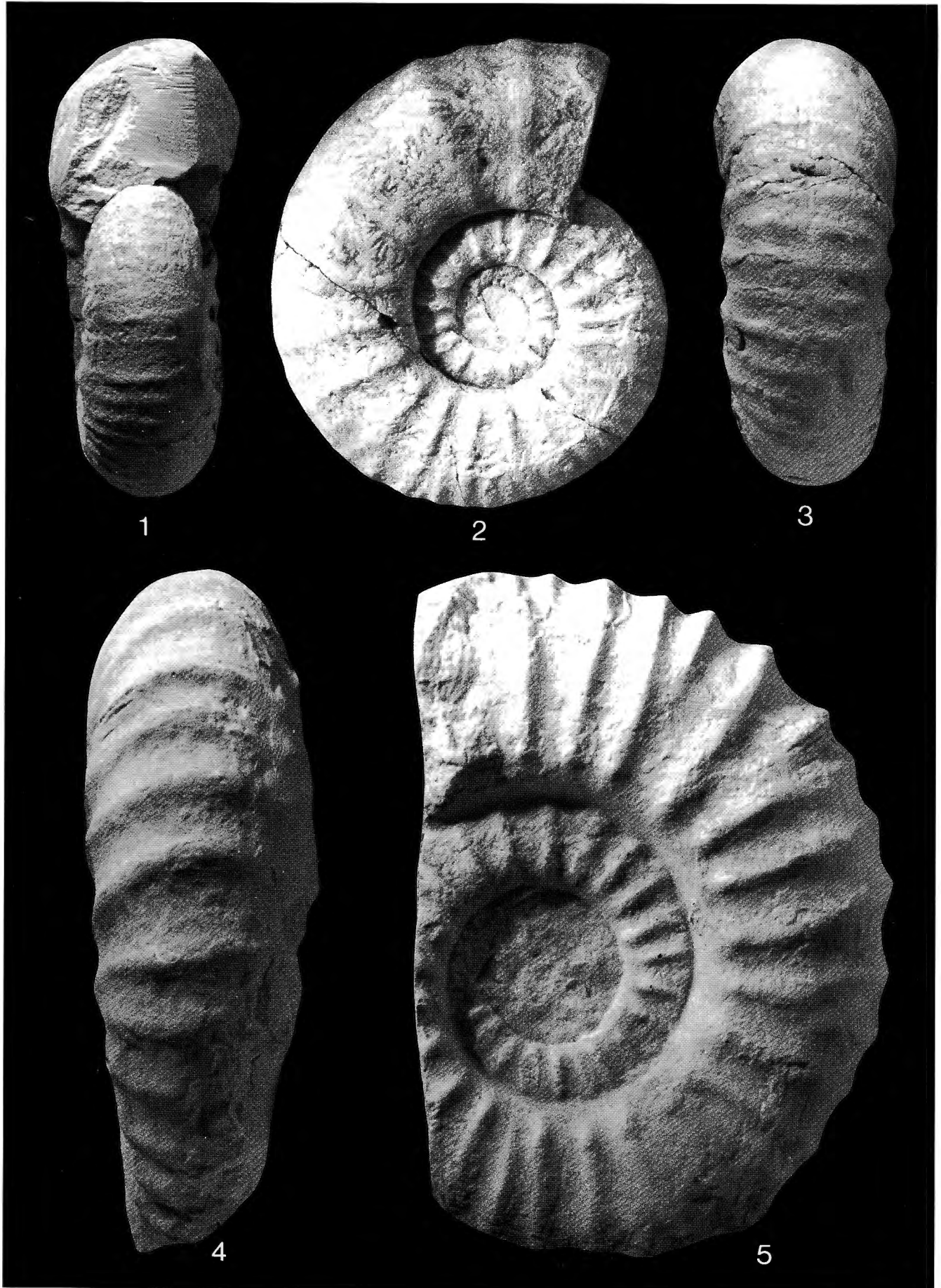
## PLATE 4

Figs. 1-5 — *Pseudokosmaticeras brandti* (REDTENBACHER, 1873).

1-3: EMP unregistered, the original of SEUNES, 1892, pl.6, fig. 2, from Tercis.

4, 5: an unregistered cast in the EMP Collections of the original of DE GROSSOUVRE, 1894, pl.23, fig.1, from the "Grande Carrière de Tercis".

All figures are x 1



## PLATE 5

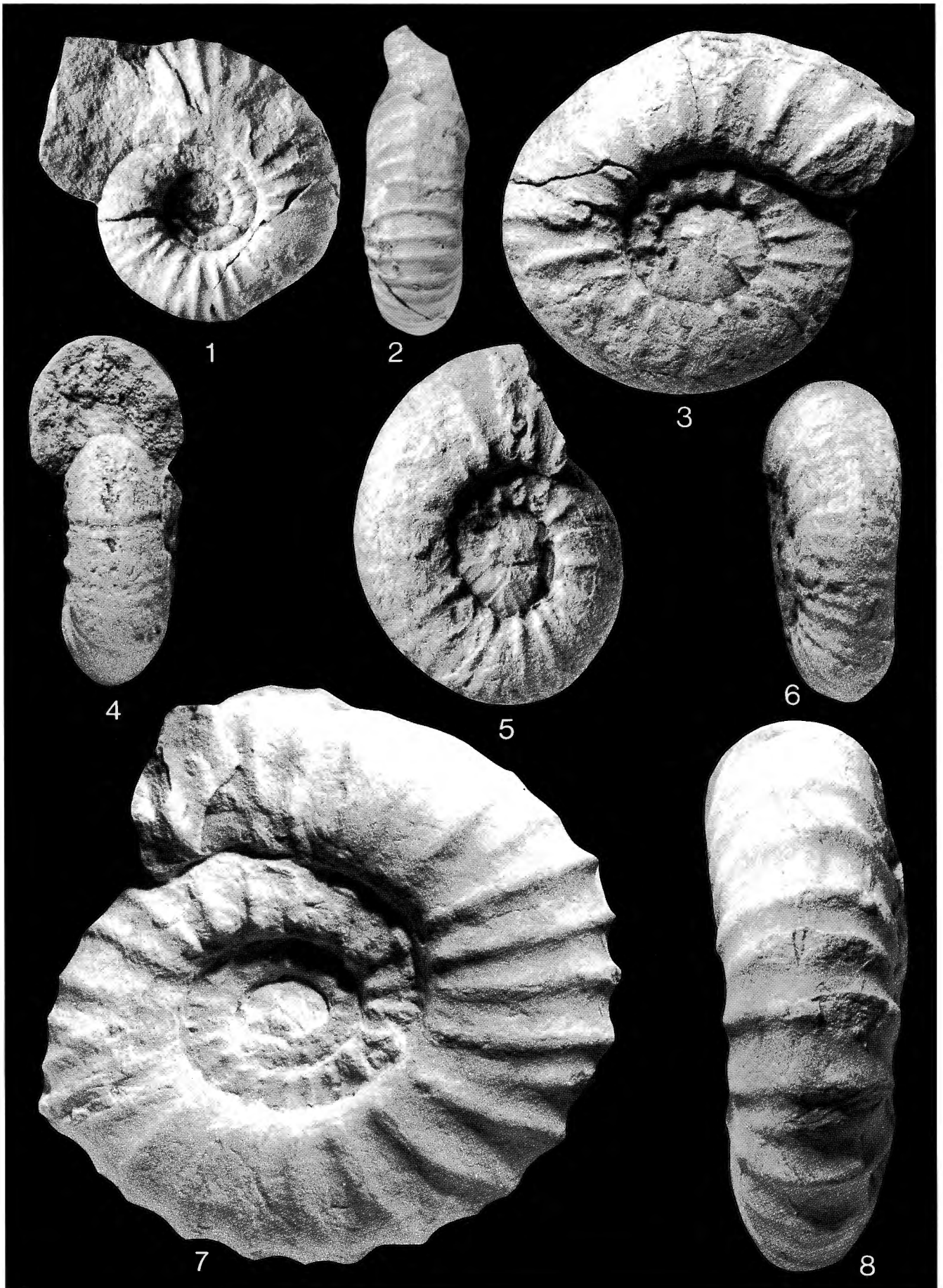
Figs. 1-8 — *Pseudokossmaticeras brandti* (REDTENBACHER, 1873).

1,2: SP unregistered, *ex* ARNAUD Collection, labelled “*Pachydiscus brandti*, Redt. Tercis, Grande Carrière, P3. Détermination De Grossouvre”.

3-6: SP unregistered, the original of DE GROSSOUVRE, 1894, pl.13, figs. 2, 3, labelled “Tercis, Grande Carrière, P3”.

7-8: SP unregistered, *ex* ARNAUD Collection, labelled “Angoumé, Grande Carrière, Q”.

All figures are x 1



## PLATE 6

Figs. 1-9 — *Pseudokosmaticeras brandti* (REDTENBACHER, 1873).

1, 2: OUM KZ 16871 from Tercis Quarry, probably from the Pale Grey Flint Member.

3-6, 7-9: two of the figured type specimens of *Pseudokosmaticeras* [*Sonneratia*] *cerevicianum* (PETHÖ, 1906) (pl.6, figs. 3, 4) from Fruska Gora, here regarded as a synonym of *P. brandti*; the originals are in the collections of the Geological Survey of Hungary, Budapest.

All figures are x 1





## PLATE 7

Figs. 1-4 — *Pseudokossmaticeras tercense* (SEUNES, 1892)

1, 2: SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus brandti*, var. *Pégoti*. Angoumé, P3, banc à *Ech. Arnaudi*. Détermination de Grossouvre”.

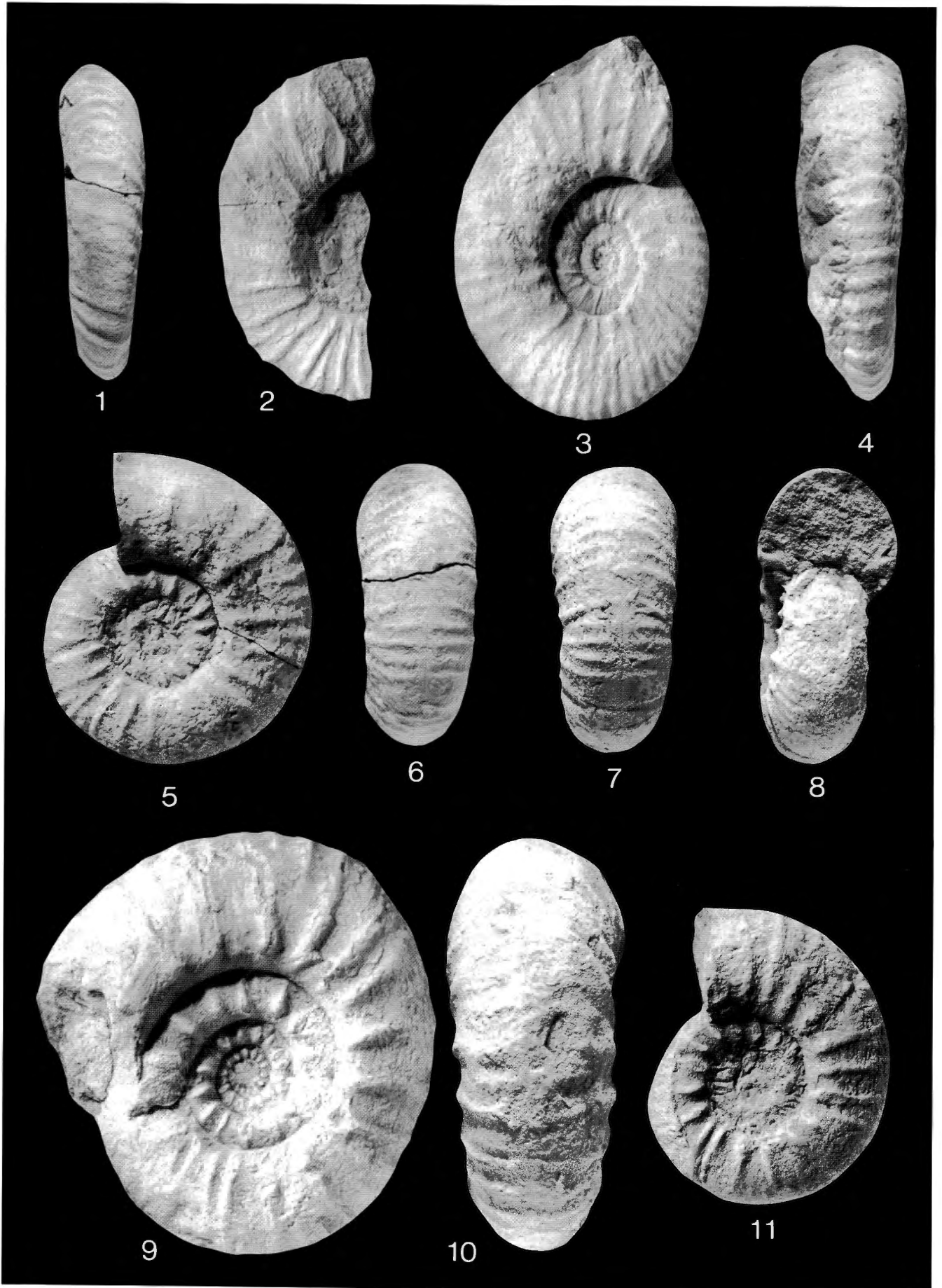
3, 4: SP unregistered, ex ARNAUD Collection, the original of *Pachydiscus Galicianus* FAVRE mut. *Tercensis* SEUNES 1892, p.16, pl.15 (6), fig.4, and of *Pachydiscus Brandti* var. *Pégoti* DE GROSSOUVRE, 1894, p.192, pl. 30, fig. 3, from Tercis.

Figs. 5-11 — *Pseudokossmaticeras brandti* (REDTENBACHER, 1873).

5-8, 11: SP unregistered, ex SEUNES Collection, the original of *Pachydiscus aturicus* SEUNES, 1892, pl. 15 (6), fig. 3, from Tercis.

9, 10: SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus brandti*, P3, Détermination de Grossouvre. Tercis, Grande Carrière”.

All figures x 1



## PLATE 8

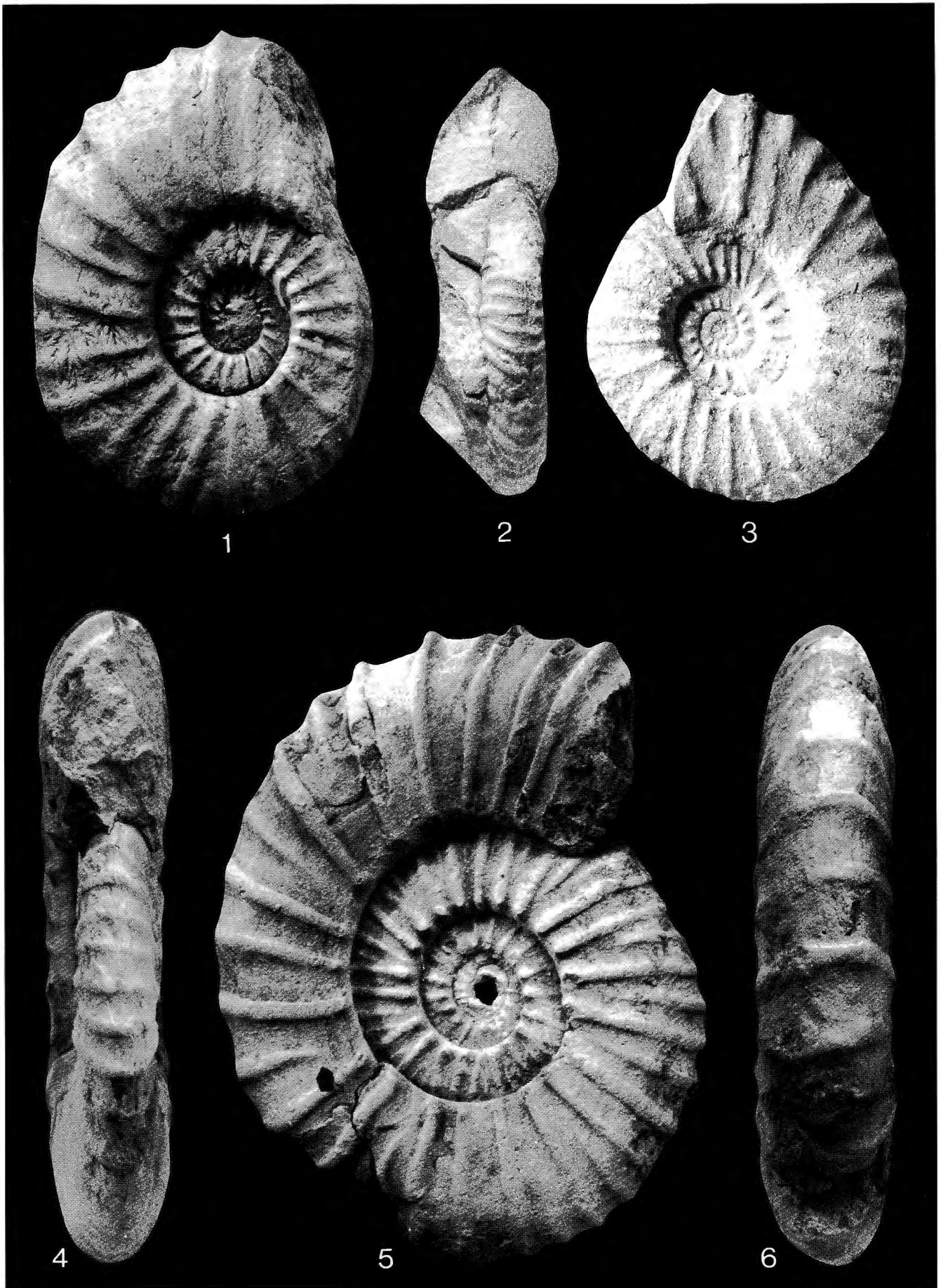
Figs. 1-6 — *Pseudokossmaticeras tercense* (SEUNES, 1892)

1: FSL 13852, from Tercis.

2, 3: EMP Collections, from Angoumé.

4-6: FSL 13852 from Tercis.

All figures x 1

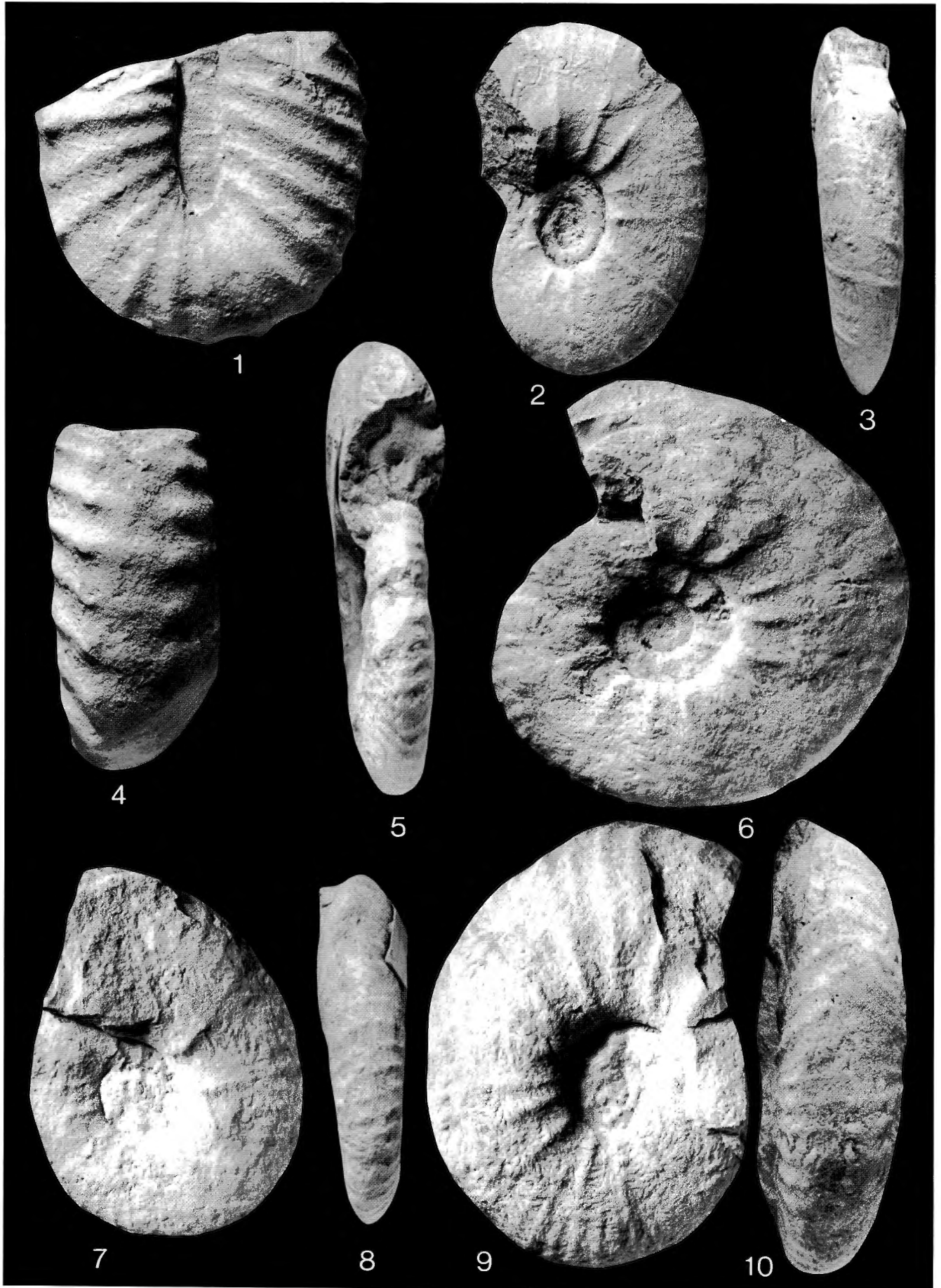


## PLATE 9

- Figs. 1, 4 — *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941. SP unregistered, labelled "Tercis, Grande Carrière, P3".
- Figs. 2, 3 — *Pachydiscus (Pachydiscus) jacquoti jacquoti* SEUNES, 1890a, labelled "*Pachydiscus Neubergicus* Hauer *jacquoti* Seunes. Tercis, La Pointe PQR. Détermination De Grossouvre".
- Figs. 5-8 — *Pachydiscus (Pachydiscus) neubergicus neubergicus* (VON HAUER, 1858), both SP unregistered, ex ARNAUD Collection, labelled "*Pachydiscus neubergicus* V.H. Angoumé P3Q".
- Figs. 9, 10 — *Pachydiscus (Pachydiscus) perfidus* DE GROSSOUVRE, 1894, OUM KZ 16844, from Unit J, Tercis Quarry.

All figures x 1







## PLATE 10

Figs. 1, 2, 4, 5 — *Pachydiscus (Pachydiscus) perfidus* DE GROSSOUVRE, 1894.

1, 2: FSL 13890, from Angoumé (ex SAYN Collection).

4, 5: SP unregistered, ex ARNAUD Collection, labelled "Angoumé P3Q".

Figs. 3, 6 — *Pachydiscus (Pachydiscus) jacquoti jacquoti* SEUNES, 1890a. The original of SEUNES, 1890b, pl.9, fig.3, labelled "Danien Inférieur, Tercis".

All figures are x 1



## PLATE 11

Figs. 1-4 — *Pachydiscus (Pachydiscus) epiplectus* (REDTENBACHER, 1873).

1, 2: SP unregistered, ex ARNAUD Collection, labelled "*Pachydiscus Fresvillensis* Seunes, carrière Duclerc, P3Q.  
*Pachydiscus colligatus* V. Bink = *epiplectus* Redtenbacher = *Fresvillensis* Seunes".

3, 4: OUM KZ 20321, ex HANCOCK Collection, from Unit N2, Tercis Quarry.

Figs. 5, 6 — *Pachydiscus (Pachydiscus) perfidus* DE GROSSOUVRE, 1894, SP unregistered, ex ARNAUD Collection, labelled  
"Angoumé, Grande Carrière, Q".

All figures are x 1



## PLATE 12

- Figs. 1-4, 6 — *Pachydiscus (Pachydiscus) perfidus* DE GROSSOUVRE, 1894.  
1: SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus brandti* det De Gross. Angoumé, Gde Carrière, P3”.  
2, 3: SP collections, from Tercis, Grande Carrière.  
4, 6: EMP Collections, ex DE MORGAN Collection, from Angoumé.
- Fig. 5 — *Saghalinites wrighti* BIRKELUND, 1965. SP unregistered, ex ARNAUD Collection, labelled “*Gaudryceras*, Angoumé, Gde. Carrière, P3”.
- Figs. 7-9 — *Pachydiscus (Pachydiscus) neubergicus neubergicus* (VON HAUER, 1858), OUM KZ 16868, from the bottom third of Unit O, Tercis Quarry.

All figures are x 1



## PLATE 13

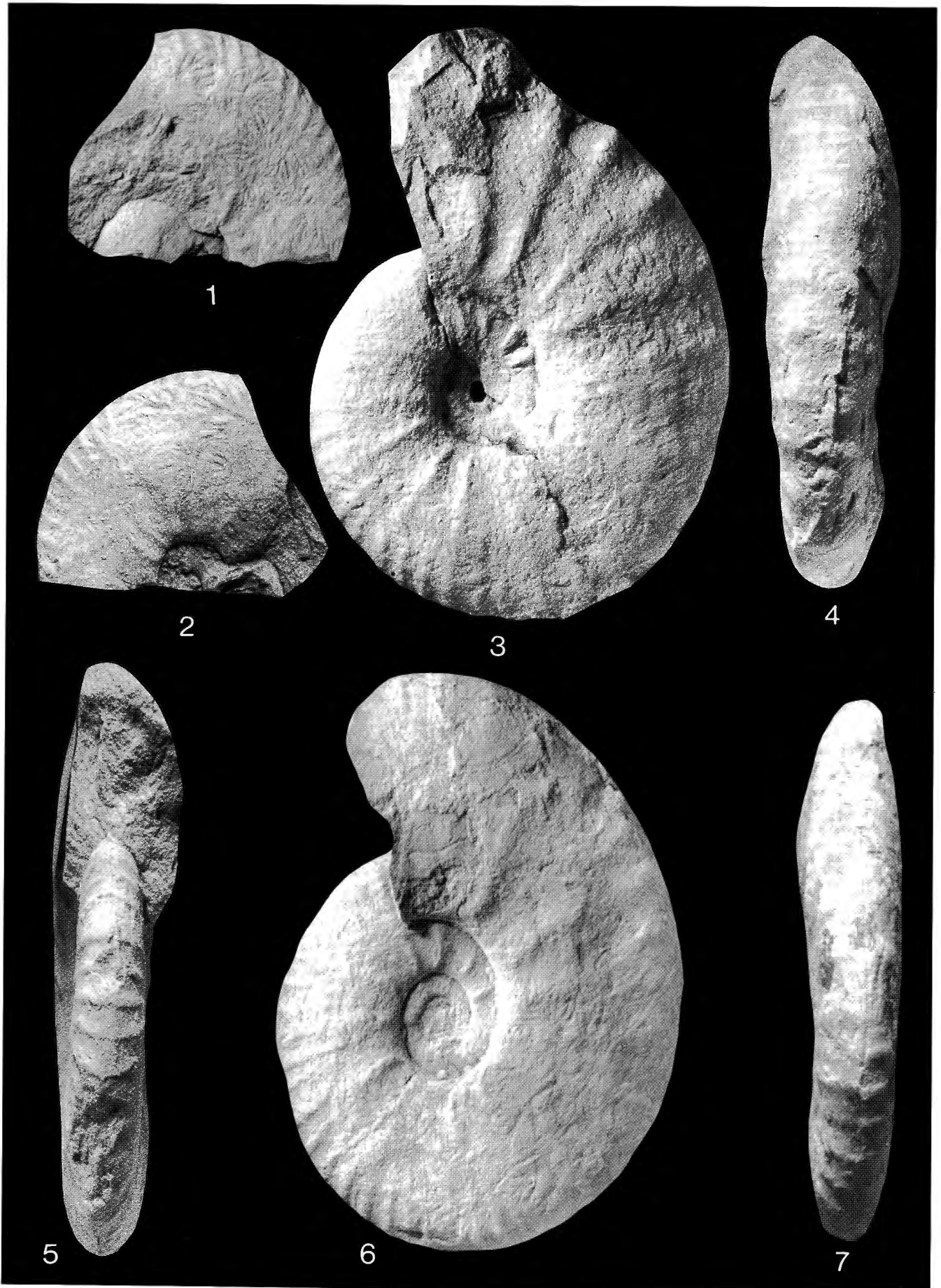
Figs. 1, 2 — *Pachydiscus (Pachydiscus) armenicus* ATABEKIAN & AKOPIAN, 1969, SP unregistered, ex ARNAUD Collection, labelled "*Pachydiscus Gollevillensis*, La Pointe P3QR, Determin de Grossouvre".

Figs. 3, 4 — *Pachydiscus (Pachydiscus) perfidus* DE GROSSOUVRE, 1894. SP unregistered, ex ARNAUD Collection; the lectotype, figured by DE GROSSOUVRE 1894, pl.34, fig.1, from the Grande Carrière, Tercis.

Figs. 5-7 — *Pachydiscus (Pachydiscus) neubergicus neubergicus* (VON HAUER, 1858). SP unregistered, ex ARNAUD Collection, labelled "Angoumé, Gde. Carrière".

All figures are x 1





## PLATE 14

Figs. 1, 5 — *Pachydiscus (Pachydiscus) epiplectus* (REDTENBACHER, 1873). SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus colligatus* V.B....Angoumé, Gde, Carrière’

Figs. 2-4 — *Nostoceras (Nostoceras) hyatti* (STEPHENSON, 1941). SP unregistered, ex ARNAUD Collection, labelled “Tercis, Gde Carrière, P3”.

All figures are x 1

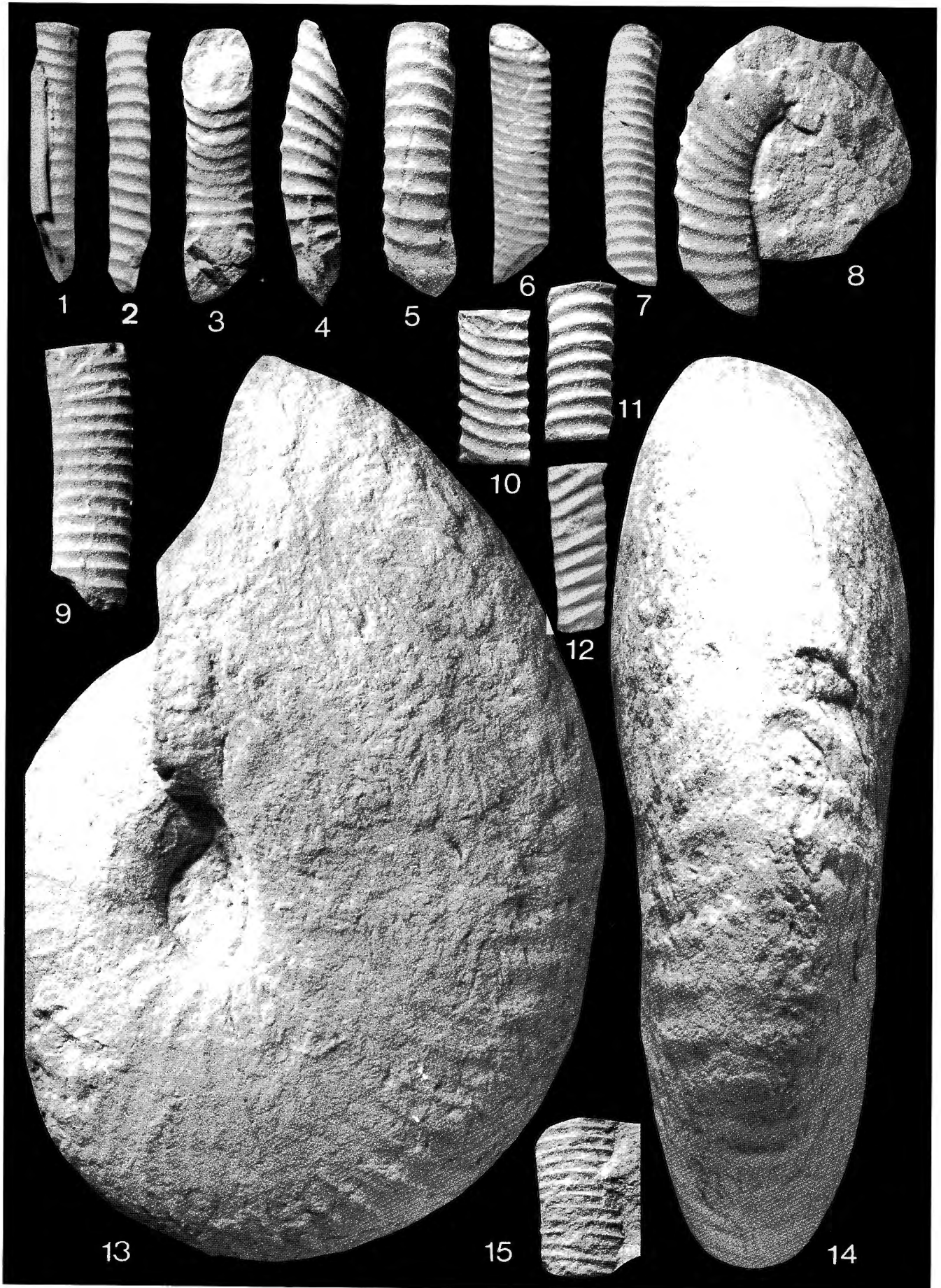


## PLATE 15

- Figs. 1-12 — *Glyptoxoceras rugatum* (FORBES, 1846). 1,2,9; 3-5,6,7,8,11-12, are all SP unregistered, ex ARNAUD Collection, labelled "*Heteroceras* sp., Tercis, La Pointe".
- Figs. 13 14 — *Pachydiscus (Pachydiscus) epiplectus* (REDTENBACHER, 1873). SP unregistered, ex SEUNES Collection, labelled "*Ammonites epiplectus* Redtenbacher" and in a second hand "Mr. Seunes, Angoumé Gde Carrière P3 determ. de Grossouvre", and in a third hand "*Am colligatus* V. Bink".
- Fig. 15 — *Diplomoceras cylindraceum* (DEFRANCE, 1816). SP unregistered ex ARNAUD Collection labelled "*Heteroceras* Tercis, La Pointe".

All figures are x 1





## PLATE 16

Figs. 1, 4-9 — *Nostoceras (Nostoceras) helicinum* (SHUMARD, 1861).

1, 4, 5, 6: the original of *Nostoceras pozaryskii* BLASZKIEWICZ 1980, pl.10, fig.14.

7-9: the holotype of *Nostoceras pozaryskii*, the original of BLASZKIEWICZ, 1980, Pl.10, Figs. 1-5; both specimens from the Upper Campanian of Piotrawin in the Middle Vistula Valley, Poland.

Figs. 2-3 — *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941, the original of *Nostoceras pozaryskii* BLASZKIEWICZ, 1980, pl.10, figs. 8, 9, 12; from the Upper Campanian, east of Melénów in the Middle Vistula Valley, Poland.

All figures are x 1





## PLATE 17

- Figs. 1-4 — *Diplomoceras cylindraceum* (DEFRANCE, 1816).  
1: SP unregistered, ex ARNAUD Collection, labelled “*Hamites - Heteroceras* Tercis, Gde Carrière Danién-Garumnien sup. W”.  
2-4: SP unregistered, associated with material labelled “Tercis, La Pointe”.
- Figs. 5-8 — *Nostoceras (Nostoceras) helicinum* (SHUMARD, 1861), SP unregistered, ex ARNAUD Collection, labelled “*Hamites* Tercis, Gde Carrière”.
- Fig. 9 — *Glyptoxoceras rugatum* (FORBES, 1846). SP unregistered, ex ARNAUD Collection, labelled “*Heteroceras polyplocum* Tercis, La Pointe”.
- Figs. 10, 11 — *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941. SP unregistered, ex ARNAUD Collection, labelled “*Heteroceras* Sp. Angoumé, Gde Carrière, Q”.

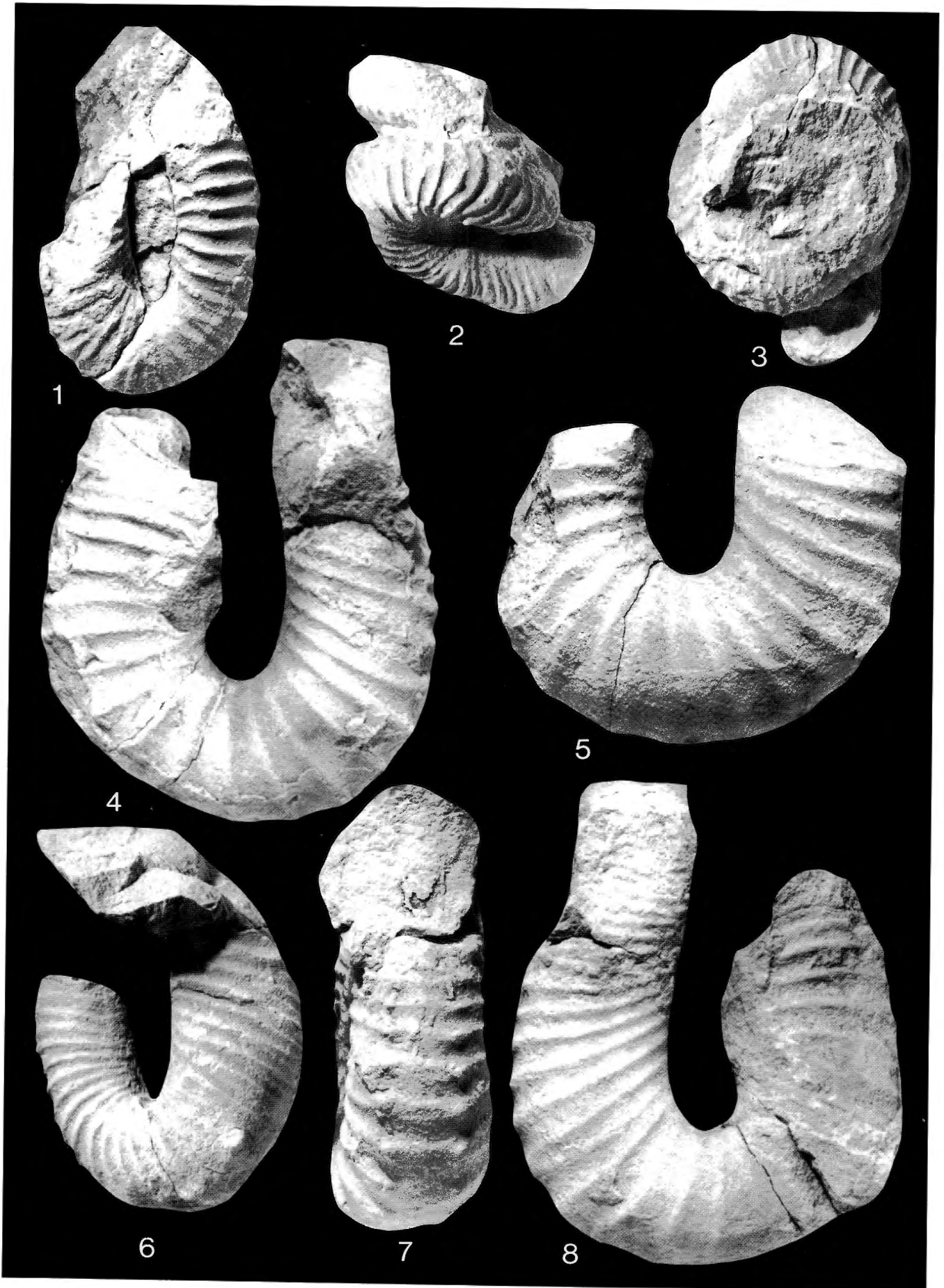
All figures are x 1



## PLATE 18

- Figs. 1, 6 — *Nostoceras (Nostoceras) helicinum* (SHUMARD, 1861).  
1: SP unregistered, ex ARNAUD Collection, labelled “*Pachydiscus Brandti* Redt. var. *Pegoti*, Angoumé, Gde Carrière. P3’.  
6: OUM KZ 16848, from Unit J, Tercis Quarry (see also Pl.19, Figs. 5-7).
- Figs. 2-5, 7, 8 — *Nostoceras (Nostoceras) hyatti* STEPHENSON 1941.  
2, 3: OUM KZ 16835, from the top quarter of Unit G, Tercis Quarry.  
4, 7, 8: SP unregistered, ex ARNAUD Collection, labelled “*Heteroceras*, Angoumé, Gde Carrière...on voit la columelle du spire”.  
5: SP unregistered, ex ARNAUD Collection, labelled “Hamites, Tercis, Grande Carrière, P3” (see also Pl.19, Figs. 8, 9).

All figures are x 1



## PLATE 19

Figs. 1-4, 8-10 — *Nostoceras (Nostoceras) hyatti* STEPHENSON, 1941.

1: EMP unregistered, from Tercis.

2-4, 10: SP unregistered, ex ARNAUD Collection, labelled “*Hamites*, Tercis, Gde Carrière, P3”.

8, 9: SP unregistered, ex ARNAUD Collection, labelled “*Hamites*, Tercis, Gde Carrière, P3” (see also Pl. 18, Fig.4).

Figs. 5, 6, 7 — *Nostoceras (Nostoceras) helicinum* (SHUMARD, 1861), OUM KZ 16848, from Unit J, Tercis Quarry (see also Pl.18, Fig.6).

All figures are x 1



## PLATE 20

- Figs. 1-4 — *Hoploscaphites constrictus* (J. SOWERBY, 1817).  
1: OUM KZ 16919, from the “upper stage on north face, Grande Carrière, Tercis”.  
2-4: OUM KZ 16863, from the bottom third of Unit O, Tercis Quarry.
- Figs. 5-8, 12, 13 — *Glyptoxoceras* sp. Three fragments, SP unregistered, ex ARNAUD Collection, labelled “Tercis, La Pointe”.
- Figs. 9-11, 14, 16-19 — *Baculites leopoliensis* NOWAK, 1908.  
9-11: OUM KZ 16856, from the upper part of Unit K, Tercis Quarry.  
14: SP unregistered, ex ARNAUD Collection, labelled “Tercis, Grande Carrière”.  
16-18: SP unregistered, ex ARNAUD Collection, labelled “Tercis, Gde. Carrière”.  
19: SP unregistered, ex ARNAUD Collection, labelled “Angoumé, P3, niveau à *Echinocorys regularis*”.
- Fig.15 — *Didymoceras* sp. nov.  
SP unregistered; labelled “*Heteroceras polyplocum*, Tercis, Grande Carrière, Q”.

All figures are x 1



