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The upper Albian and lower Cenomanian succession at Kolbay, eastern Mangyshlak (southwest Kazakhstan)

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Abstract

The Kolbay promontory in southwest Kazakhstan exposes a 90-metre section of shallow-marine, terrigenous clastic upper upper Albian and lower lower Cenomanian sediments. The section is described, and a sedimentological and sequence-stratigraphical interpretation are proposed. The youngest Albian ammonite fauna is referred to the *Mortoniceras* (*Subschloenbachia*) *perinflatum* Zone; it comprises *Arrhaphoceras* (*A.*) *subtetragonum* SPATH, 1928, *Callihoplites dorsetensis* SPATH, 1928, *Lepthoplites gracilis* SPATH, 1928, *Placenticeras kolbajense* (SOKOLOV, 1967) (type locality), *Idiohamites dorsetensis* SPATH, 1939 and *Lechites* (*L.*) *moreti* BREISTROFFER, 1936. The oldest Cenomanian fauna comes from 60 metres higher in the section, and can be referred to the lower *Neostlingoceras carcitanense* Subzone of the lower lower Cenomanian *Mantelliceras mantelli* Zone. It comprises *Placenticeras mediasiaticum* LUPPOV, 1963, *Schloenbachia varians* (J. SOWERBY, 1817), *Mantelliceras saxbii* (SHARPE, 1857), *Mantelliceras lymense* (SPATH, 1926b) and *Algerites ellipticus* (MANTELL, 1822). The interval between these two faunas lacks age-diagnostic macrofossils, but the section between 47.5 and 55.2 metres above the base of the sequence has yielded the most diverse shark and ray fauna of late Albian to early Cenomanian age known to us, with isolated teeth representing a total of more than twenty-seven species.

Keywords: Albian, Cenomanian, ammonites, elasmobranchs, stratigraphy, Kazakhstan

Résumé

Une coupe de 90 mètres de sédiments marins peu profonds, clastiques et terrigènes, datés de la partie supérieure de l'Albien supérieur et de la partie inférieure du Cénomanien inférieur est exposée dans le promontoire de Kolbay au sud-ouest du Kazakhstan. La coupe est décrite et son interprétation sédimentologique et en termes de stratigraphie sequentielle est proposée. La faune d'ammonites la plus récente de l'Albien est attribuée à la Zone à *Mortoniceras* (*Subschloenbachia*) *perinflatum* et comprend *Arrhaphoceras* (*A.*) *subtetragonum* SPATH, 1928, *Callihoplites dorsetensis* SPATH, 1928, *Lepthoplites gracilis* SPATH, 1928, *Placenticeras kolbajense* (SOKOLOV, 1967) (localité type), *Idiohamites dorsetensis* SPATH, 1939 et *Lechites* (*L.*) *moreti* BREISTROFFER, 1936. La plus ancienne faune du Cénomanien apparaît 60 mètres plus haut dans la coupe et peut être attribuée à la partie inférieure de la Sous-zone à *Neostlingoceras carcitanense*, Zone à *Mantelliceras mantelli* de la partie inférieure du Cénomanien inférieur. Elle comprend: *Placenticeras mediasiaticum* LUPPOV, 1963, *Schloenbachia varians* (J. SOWERBY, 1817), *Mantelliceras saxbii* (SHARPE, 1857), *M. lymense* (SPATH, 1926b) et *Algerites ellipticus* (MANTELL, 1822). L'intervalle entre ces deux faunes est dépourvu de macrofossiles permettant une datation, mais l'intervalle entre 47,5 et 55,2 m au-dessus de la base de la coupe contient l'assemblage de requins et de raies d'âge Albien tardif à Cénomanien précoce le plus diversifié que nous connaissons, aves des dents isolées totalisant plus de vingt-sept espèces.

Mots-clefs: Albien, Cénomanien, ammonites, élasmobranches, stratigraphie, Kazakhstan.

Introduction

The Mangyshlak anticlinorium, in southwest Kazakhstan, extends for 300 km from the Caspian Sea to the western border of the Ustyurt Plateau, trending westnorthwest-eastsoutheast (Fig. 1). It comprises gently folded Mesozoic and Paleogene sediments, overlain unconformably by near-horizontal Neogene strata which form the surface of the Ustyurt Plateau and a number of outliers further west. Marine mid-Cretaceous rocks are extensively exposed in the Mangyshlak anticlinorium; their regional stratigraphy and correlation were analysed through the study of seven key sections by MARCINOWSKI *et al.* (1996).

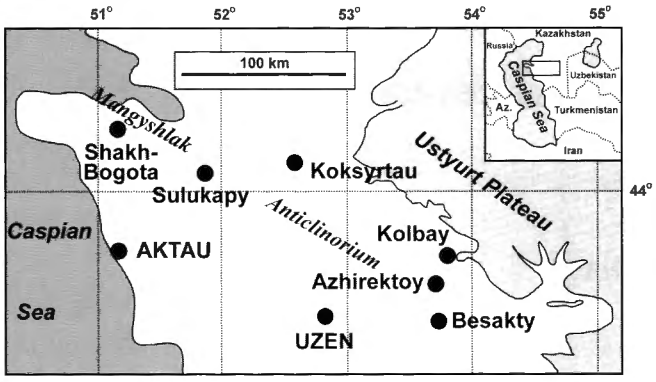

Fig. 1 – Location of the Kolbay section and other sections in the Mangyshlak anticlinorium mentioned in the text. Inset map: Az. - Azerbaijan.

GALE *et al.* (1999) studied the biostratigraphy and sequence stratigraphy of the Cenomanian sucession in three of these, namely at Koksyrtau, Shakh-Bogota and Sulukapy, in the western Mangyshlak anticlinorium (Fig. 1).

No formal lithostratigraphic nomenclature exists for the Cretaceous successions in this area. The upper Albian and lower Cenomanian are represented in the eastern Mangyshlak anticlinorium mainly by non-calcareous fine sands and sandy clays. Macrofossils occur mainly in a few thin phosphatic beds and in layers of calcareous concretions.

In the eastern part of the Mangyshlak anticlinorium, in the Besakty and Azhirektoy sections (studied by MARCINOWSKI *et al.*, 1996) and at Kolbay, described here, the upper Albian and lower Cenomanian are relatively expanded, in comparison to sections further west (MARCINOWSKI *et al.*, 1996, fig. 14). The upper Albian succession is more than 120 metres thick, the lower Cenomanian around 45 metres. Detailed lithostratigraphic correlation within this interval was not carried out by MARCINOWSKI *et al.* (1996), who concentrated on the biostratigraphy of the sequence.

The Kolbay section

The section studied (co-ordinates: 43° 41' 46.3" N, 53° 58' E 52.0" E) is near the eastern end of the Mangyshlak anticlinorium, on a westward-projecting promontory of the escarpment bordering the Ustyurt Plateau (Fig. 1). Here, approximately 90 m of mid-Cretaceous (upper Albian and lower Cenomanian) sediments are exposed (Figs 2, 3), overlain unconformably by Neogene limestones of the Ustyurt Plateau. Underlying Albian and overlying younger Cenomanian and Turonian sediments are exposed nearby, but were not examined during the present study. The Kolbay section was not studied by MARCINOWSKI *et al.* (1996), but is approximately 20 km northeast of their Azhirektoy section, and approximately 50 km northnortheast of their Besakty section (Fig. 1).

At Kolbay, the dominant lithologies are silty and sandy clays and silty to fine sands, interbedded on

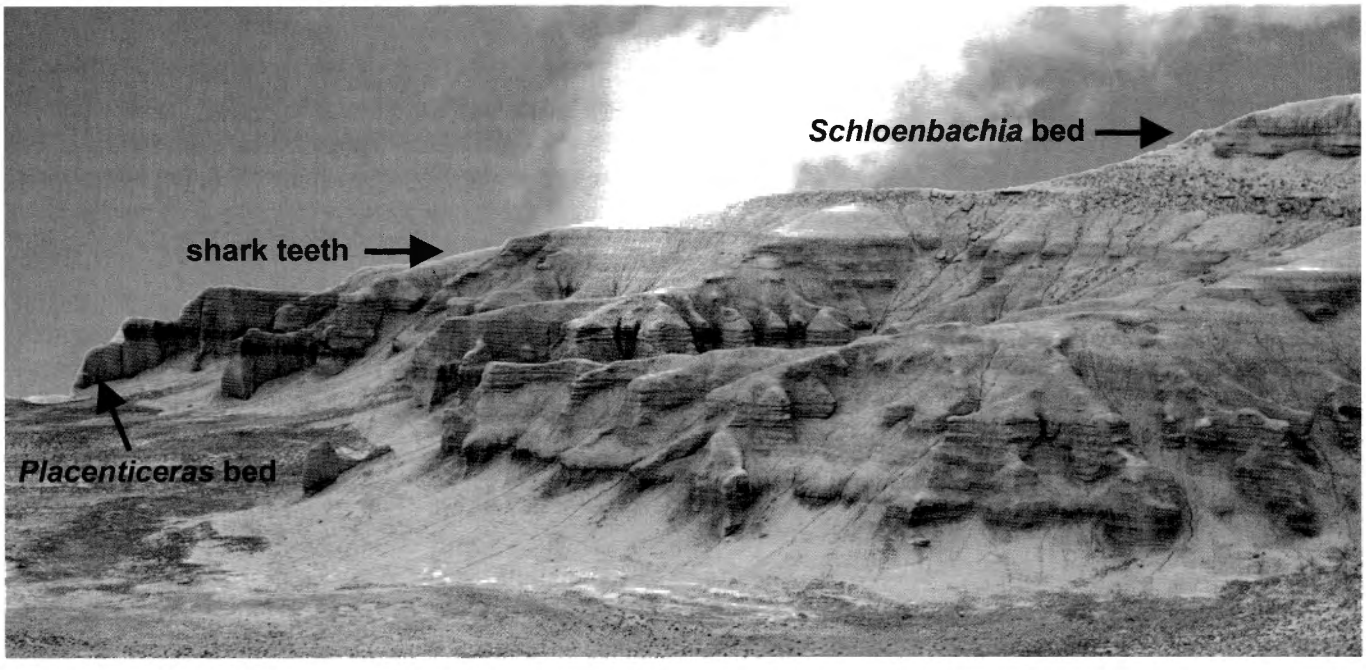

Fig. 2 – The Kolbay section, viewed from the south. The height of the escarpment is approximately 90 metres (photograph by Tatiana Malyshkina, Institute of Geology, Ekaterinburg).

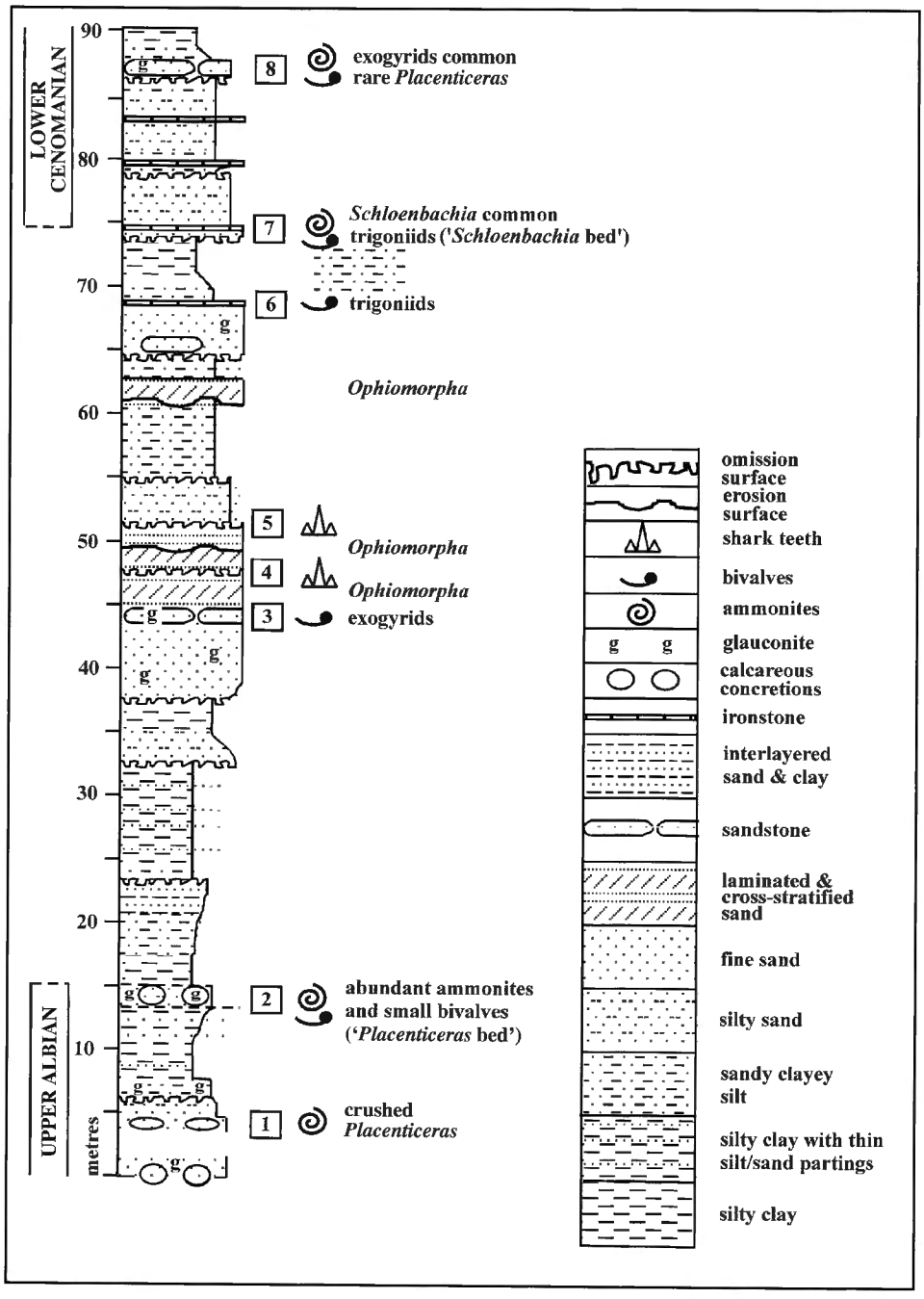

Fig. 3 – Stratigraphy of the Kolbay section; numbers refer to fossil levels described in the text. Thickness is in metres.

a metric to decametric scale (Fig. 3). Contacts are generally sharp and are often burrowed omission surfaces. Between 44.5 m and 62.4 m above the base, there are several units of laminated and cross-stratified sand with *Ophiomorpha* burrow systems. The entire section is decalcified, except for concretion levels; molluscs occur only in a few thin beds.

Macrofauna

Macrofossils have been recorded from eight levels, here designated horizons 1 to 8 (Fig. 3). In the following account, they are located in the section in terms of height above the base of the section, in metres.

Level 1 (4.0 m): A thin layer of hummocky cross-stratified sand with large tabular calcareous sandstone concretions. There is a concentration of crushed *Placenticeras* at the base.

Level 2 (14.0-15.0 m): the '*Placenticeras* bed' - large subspherical silty limestone concretions in glauconitic sandy silt. These are frequently packed with well-preserved ammonites (predominantly *Placenticeras*), small bivalves (mostly *Aucellina*) and some gastropods. The ammonites often retain their aragonitic shell, but are frequently fragmentary (although not abraded) and

randomly oriented. The specimens of *Placenticeras* comprise a wide range of ontogenetic stages and morphologies.

Level 3 (44.55-45.15 m): tabular calcareous sandstone with dispersed fine phosphate. Common exogyrid bivalves and moulds of aragonitic molluscs.

Levels 4 (47.4 m) and *5* (51.60 m): fine sands overlying inter-burrowed omission surfaces. They contain common, well-preserved shark and ray teeth and teleost bone fragments, as listed below.

Level 6 (68.4 m): thin irregular 'ironstone' (limonite-cemented sandstone) with common limonitic casts of trigoniid bivalves.

Level 7 (74.3 m): the '*Schloenbachia* bed' – a thin layer of limonitic sand with common molluscs, preserved as limonitic casts and moulds. Turritellid gastropods, trigoniid and cucullaeid bivalves and ammonites are frequent; the ammonites are almost entirely *Schloenbachia* and *Placenticeras*.

Level 8 (86.7-86.9 m): tabular calcareous sandstone with common bivalved exogyrids, moulds of aragonitic molluscs and a poorly preserved *Placenticeras*. Abraded shark teeth are frequent. A single, *ex situ* specimen of the belemnite *Praeactinocamax primus* (ARKHANGELSKY, 1912) (identified by C.J. Wood) probably is from this bed.

The ammonites described below are from levels 2 and 7.

Depositional environments

Detailed analysis of depositional environments has not been carried out, but sedimentological features indicate deposition mainly in coastal and shallow-marine environments. Five main facies can be differentiated, as follows:

1. Laminated/planar cross-stratified sand with *Ophiomorpha*, often with erosional basal contacts, with thin clay interbeds or flasers at some levels. These are interpreted as the most proximal facies, probably representing coastal beach/barrier sands and tidally influenced coastal environments;
2. Heterolithic sediments (thinly interbedded and interlaminated silt/fine sand and clay), with limited bioturbation. These probably represent tidally influenced nearshore environments; the predominantly low-energy character and apparent absence of macrofauna suggests a somewhat restricted (bay?) environment;
3. Bioturbated silty and fine sand, in part glauconitic. These are interpreted as inner neritic marine sediments;
4. Bioturbated silty clay and clayey silt. These may be deeper marine neritic sediments, but the absence of macrofauna limits interpretation;
5. Mollusc-rich units. Most of the units with molluscs have features indicative of slow and/or interrupted sedimentation in a low-energy neritic environment (thin beds, occurrence of glauconite/phosphate, no evidence of reworking or transport, bivalves often articulated). They are interpreted here as condensed units.

Depositional sequences

The sequence stratigraphy of the Cenomanian in western Europe and Tunisia has been studied by ROBASZYNSKI *et al.* (1994, 1998), who identified six sequences. Four or five of these have been recognised in the western Mangyshlak anticlinorium (GALE *et al.*, 1999), where there is a disconformity at the Albian/Cenomanian boundary. The upper Albian and lower Cenomanian are much more expanded in the eastern Mangyshlak anticlinorium, and a more complete sedimentary record is probably preserved there. A tentative sequence-stratigraphic interpretation for the Kolbay section is proposed here; it must be emphasised that further regional study is necessary before this can be regarded as validated.

The sands and sandy clays at the base of the section, partly glauconitic (0-14.0 m), are tentatively regarded as part of a transgressive sequence tract (TST). The '*Placenticeras* bed' (level 1) is characterised by a significant glauconite content, intense bioturbation and a molluscan concentration. It is interpreted as a condensed unit representing the maximum flooding surface (MFS). The overlying interval (*c.* 15.5-32.85 m) is dominated by silty clays and heterolithic sediments, capped by a fine glauconitic sand and is interpreted as a highstand systems tract (HST). The shelly sandstone with phosphate at 44 m (Level 3) is overlain by cross-bedded and laminated sand with *Ophiomorpha* and concentrations of vertebrate debris. This abrupt facies change, suggesting a hiatus/condensation followed by significant shallowing, is interpreted as marking a sequence boundary. The overlying unit is regarded as a lowstand systems tract (LST). There is a progressive upward decrease in grain size up to 64 m, interrupted by a cross-bedded sand with *Ophiomorpha* between 60.4-61.5 m. Differentiation between the LST and the overlying TST in this interval is unclear; a bioturbated glauconitic sand at 64-68.4 m based by an interburrowed omission surface is tentatively regarded as the base of

the TST. The overlying shelly unit (Level 6) contains only bivalves, but in the next shelly unit (Level 7) ammonites are also common, indicating progressive retrogradation. Level 8, a shelly sandstone, may mark the MFS, with overlying silty clay representing the base of the HST.

The Kolbay section cannot easily be compared with the sections in the western Mangyshlak anticlinorium analysed by GALE *et al.* (1999), where there is a disconformity at the Albian/Cenomanian boundary, and the lowermost Cenomanian is absent. The base of sequence 1 (GALE *et al.*, 1999) represents a major sea level fall (base of sequence Al 11 of HARDENBOL *et al.*, 1998) which occurs approximately at the Albian/Cenomanian boundary. Data from the expanded section in Tunisia (ROBAZYNSKI *et al.*, 2007) indicate that the Albian/Cenomanian boundary (as recently defined by KENNEDY *et al.*, 2004) falls within the LST of sequence 1. It is thus probable that the proposed sequence boundary at 44 m in the Kolbay section represents the base of Cenomanian sequence 1, and that the Albian/Cenomanian boundary falls within the interval 44-64 m. This is consistent with the available biostratigraphic data. A number of interburrowed omission surfaces (Fig. 2) probably represent parasequence boundaries.

It is clear that this region preserves an expanded sedimentary record across the Albian/Cenomanian boundary, in shallow-marine environments in which relatively minor shifts in depositional environments are likely to be documented. Thus, it merits further study.

Correlation with the Azhirektoy and Besakty sections

The Azhirektoy and Besakty sections, described by MARCINOWSKI *et al.* (1996), are in the same area as the Kolbay section, and have similarly expanded upper Albian and lower Cenomanian sequences (Fig. 4). Detailed comparison with the Kolbay section is difficult, due to the rather generalised lithological descriptions of the other sections. It is probable that the '*Placenticeras* bed' is represented by Phosphatic Horizon III of MARCINOWSKI *et al.* (1996). The '*Schloenbachia* bed' is probably represented by their Bed 25 at Azhirektoy and Bed 25 at Besakty. These are the lowest units with Cenomanian ammonites in these sections. As noted by GALE *et al.* (1999), the ammonite assemblage from Bed 25 at Besakty indicates the *Neostlingoceras carcitanense* Subzone of the lower lower Cenomanian *Mantelliceras mantelli* Zone. The lowstand unit between these units with the extraordinarily rich fish

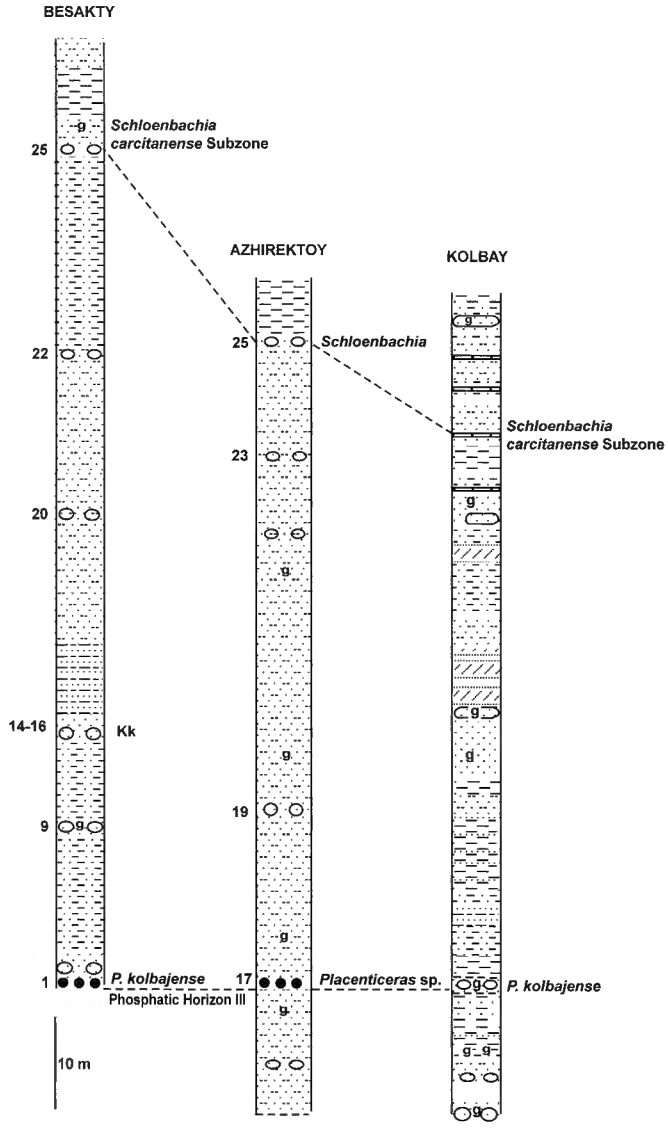

Fig. 4 – Tentative correlation of Besakty, Azhirektoy and Kolbay sections (data and bed numbers for the two first-named from MARCINOWSKI *et al.*, 1996). For key, see Fig. 1.

fauna listed below does not appear to be represented in either the Azhirektoy or Besakty sections.

Composition and age of ammonite faunas

Fossil horizon 2 in the Kolbay section has yielded the following ammonite species: *Arrhaphoceras* (*A.*) *subtetragonum* (Pl. 1, Figs 1-22), *Callihoplites dorsetensis* (Pl. 6, Figs 1, 2), *Lepthoplites gracilis* (Pl. 6, Figs 4, 5), *Placenticeras kolbajense* (Pl. 2, Figs 1-17; Pl. 3, Figs 1-14; Pl. 4, Figs 9, 10, 14; Pl. 5, Figs 4-6; Pl. 8, Figs 17, 18), *Idiohamites dorsetensis* (Pl.

7, figs 1-13; Pl. 8, Figs 3-12, 19, 20) and *Lechites moreti* (Pl. 8, Figs 14-16). This is a fauna of the classic and now redundant *Stoliczkaia dispar* Zone of authors, currently replaced by the following upper upper Albian zonal sequence (KENNEDY & LATIL, 2007; KENNEDY *et al.*, 2008), from young to old: the *Arrhaphoceras* (*Praeschloenbachia*) *briacensis* Zone, the *Mortoniceras* (*Subschloenbachia*) *perinflatum* Zone, the *Mortoniceras* (*Subschloen-bachia*) *rostratum* Zone, and the *Mortoniceras* (*Mortoniceras*) *fallax* Zone. On the basis of previous records from southern England, most notably the *perinflatum* [*dispar*] Zone Ammonite Bed on the Dorset coast and the Bookham Conglomerate of inland Dorset (SPATH, 1923-1943; WRIGHT *in* ARKELL, 1947; BRISTOW *et al.*, 1995), the stratotype Vraconnien of Sainte-Croix, Switzerland (RENZ, 1968) and the expanded sucessions in the Marnes Bleues of the Vocontian Basin (GALE *et al.*, 1996; work in progress), the association of *Arrhaphoceras subtetragonum*, *Callihoplites dorsetensis*, *Lepthoplites gracilis*, *Idiohamites dorsetensis* and *Lechites moreti* indicate the *perinflatum* Zone.

Fossil horizon 7 in the Kolbay section has yielded the following species: *Placenticeras mediasiaticum* (Pl. 4, Figs 1-8, 11-13; Pl. 5, Figs 1-3, 7-9), *Schloenbachia varians* (Pl. 5, Figs 10-12, 14, 15; Pl. 6, Figs 3, 6-13), *Mantelliceras saxbii* (Pl. 5, Fig. 13), *M. lymense* (Pl. 5, Fig. 16) and *Algerites ellipticus* (Pl. 8, Figs 1, 2). This is an Early Cenomanian assemblage, *Algerites ellipticus* being restricted to the lower, *Neostlingoceras carcitanense* Subzone of the lower lower Cenomanian *Mantelliceras mantelli* Zone, thus precisely dating the assemblage.

The base of the Cenomanian Stage is currently defined by the first appearance of the planktonic foraminiferan *Rotalipora globotruncanoides* 36 metres below the top of the Marnes Bleues Formation in the Global Boundary Section to the south of Mont Risou in Hautes-Alpes, France (KENNEDY *et al.*, 2004). This falls within the *briacensis* ammonite Zone (see above), and ammonites of the *carcitanense* Subzone first appear six metres above the boundary level. On this basis, the Albian/Cenomanian boundary must lie below the level of fossil horizon 7 in the Kolbay sequence.

The fish fauna

A wholly unexpected discovery in the Kolbay section was what is the most diverse latest Albian to earliest Cenomanian shark and ray assemblage known to us. The material is in the form of isolated teeth, which occur scattered through four metres of sands, with concentrations at fossil levels 4 and 5 of the log (Fig. 2). Level 4 yielded phosphatised coprolites and small (< 1 cm) elasmobranch teeth and bony fish debris. Level 5 yielded mainly large (> 1 cm or more) teeth, principally *Cretoxyrhynchia denticulata* GLYCKMAN, 1957, together with rare ichthyosaur and plesiosaur debris.

The following list is based on isolated teeth only; abbreviations are as follows: A – abundant; C – common; F – frequent; O – occasional; R – rare.

1. Sharks

Meristodon sp. *('Hybodus')* (almost all typically lack roots)	C
Polyacrodus illingworthi DIXON, 1850	R
Polyacrodus spp.	O
Synechodus dubrisiensis (MACKIE, 1863)*	
(* inclusive of *S. nitidus* and *S. tenuis* morphotypes)	F
Paraorthacodus recurvus (TRAUTSCHOLD, 1877)	O
Squatina decipiens (DALINKEVIČIUS, 1935)	O
Squalus sp.	R
Heterodontus sp. (broad-crowned lateral teeth)	A
Orectoloboides parvulus DALINKEVIČIUS, 1935	R
Cretorectolobus doylei UNDERWOOD *et al.*, 1999	R
?*Cederstromia* or *Cretorectolobus* sp.	C
Palaeoanacorax volgensis (GLYCKMAN *in* GLYCKMAN & SHVAZHAITE, 1971)	O
Squalicorax cf. *baharijensis* (STROMER, 1927)	R
Archaeolamna cf. *kopingensis* (DAVIS, 1890)	O
Cretalamna appendiculata (AGASSIZ, 1843)	F
Dwardius woodwardi (HERMAN, 1977)	O
Cretoxyrhina denticulata GLYCKMAN, 1957	C
Protolamna sokolovi CAPPETTA, 1980	A
Cretodus longiplicatus WERNER, 1989	C
Hispidaspis lasuri ZHELEZKO, 2000	A
Paraisurus macrorhizus (PICTET & CAMPICHE, 1858)	R
Scapanorhynchus praeraphiodon SOKOLOV, 1978	C
Carcharias sp.	C
Protoscyliorhinus lamaudi BIDDLE & LANDEMAINE, 1988	F

2. Rays

Squatirhina thiesi BIDDLE, 1993	F
Turonibatis cappettai LANDEMAINE, 1991	A
'Rhinobatos' sp.	O

Repositories of specimens

The following abbreviations are used to indicate the repositories of specimens cited in the text: BMNH – The Natural History Museum, London; GSM – British Geological Survey, Keyworth, Nottinghamshire; OUM – Oxford University Museum of Natural History, Oxford.

Conventions

Dimensions are given in millimetres: D = diameter; Wb =

whorl breadth; Wh = whorl height; U = umbilicus; c = costal dimension; ic = intercostal dimension. Figures in parentheses are dimensions as a percentage of diameter. The suture terminology is that of KORN *et al.* (2003): E = external lobe; A = adventive lobe (= lateral lobe, L, of KULLMANN & WIEDMANN, 1970); U = umbilical lobe; I = internal lobe.

Systematic palaeontology (W.J. Kennedy)

Order Ammonoidea VON ZITTEL, 1884
Suborder Ammonitina HYATT, 1889
Superfamily Hoplitoidea H. DOUVILLÉ, 1890
Family Hoplitidae H. DOUVILLÉ, 1890
Subfamily Hoplitinae H. DOUVILLÉ, 1890
Genus *Lepthoplites* SPATH, 1925b

Type species: *Lepthoplites falcoides* SPATH, 1925b, p. 144; 1926a, pl. 13, fig. 7, by subsequent designation of SPATH (1928, p. 231).

Lepthoplites gracilis SPATH, 1928
Pl. 6, Figs 4, 5

1860 – *Ammonites renauxianus* D'ORB. – PICTET & CAMPICHE, p. 233, pl. 31, fig. 5.
*1928 – *Pleurohoplites renauxianus* var. *gracilis* SPATH, p. 243.
1968 – *Lepthoplites gracilis* (SPATH) – RENZ, p. 36, pl. 4, figs 12-14; text-fig. 13f.
2007 – *Anahoplites gracilis* (SPATH, 1928) – SZIVES, p. 98, pl. 28, fig. 15 (with additional synonymy).

Type
The holotype, by monotypy, is no. 39873 in the collections of the Musée géologique, Lausanne, the original of PICTET & CAMPICHE (1860, pl. 31, fig. 5), refigured by RENZ (1968, pl. 4, fig. 12), from la Vraconne, Sainte-Croix, Kanton Waadt, Switzerland.

Material
OUM KY 3860, from fossil horizon 2 in the Kolbay section, upper Albian, *perinflatum* Zone.

Description
The specimen is a complete adult, 53 mm in diameter, with a 240° sector of body chamber preserved. Coiling is initially moderately involute, but becomes increasingly evolute around the outer whorl as the umbilical seam egresses in association with maturity, coming to comprise 26% of the diameter at the apertural end of the outer whorl. It is shallow, with a low, flattened, outward-inclined wall and a narrowly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.56, the greatest breadth just outside the umbilical shoulder. The inner to middle flanks are very feebly convex, subparallel, the outer flanks converge to sharp ventrolateral shoulders. The narrow venter is very feebly convex. Eighteen to nineteen tiny, strongly prorsiradiate, concave bullae perch on the umbilical shoulder. They give rise to a narrow prorsiradiate rib that bifurcates on the inner flank, or a pair of narrow ribs. The ribs strengthen across the flanks. They are feebly convex on the inner to mid-flank, feebly concave on the outer flank and projected forwards on the outermost flank. All bear delicate oblique ventral clavi. Ventral ornament is poorly preserved, but the clavi are seen to alternate in position on either side of the venter. Ornament coarsens on the body chamber. The adult aperture follows a sinuous, prorsiradiate course.

Discussion
With only a single specimen it is difficult to assess the relationship to a number of similar, feebly ornamented *Lepthoplites*. Species such as *Lepthoplites falcoides* SPATH, 1926 and *Lepthoplites cantabrigiensis* SPATH, 1928 of RENZ (1968) could be no more than intraspecific variants of a single species.

Occurrence
Upper Albian, *perinflatum* Zone, southeast France, Switzerland, Hungary, Kolbay, Kazakhstan and central Iran.

Genus *Callihoplites* SPATH, 1925a

Type species: *Ammonites catillus* J. DE C. SOWERBY, 1827, p. 123, pl. 564, by original designation (SPATH, 1925a, p. 81).

Callihoplites dorsetensis SPATH, 1928
Pl. 6, Figs 1, 2

*1928 – *Callihoplites tetragonus* (SEELEY) var. *dorsetensis* SPATH, p. 211, pl. 22, figs 9, 10.
1947 – *Pleurohoplites* (*Callihoplites*) *tetragonus* var. *dorsetensis* SPATH – BREISTOFFER, p. 61.
1968 – *Callihoplites tetragonus dorsetensis* SPATH – RENZ, p. 39, pl. 5, fig. 6; text-fig. 14h.

Types
The lectotype, here designated, is BMNH C31136, the original of SPATH (1928, p. 211, pl. 22, fig. 9). The paralectotype is BMNH C41980, the original of SPATH (1928, p. 211, pl. 22, fig. 10), from the *perinflatum* Zone ammonite bed in the upper part of the Upper Greensand

below Holworth House, Dorset.

Material
OUM KY 3838, from fossil horizon 2 in the Kolbay section, upper Albian, *perinflatum* Zone.

Description
The specimen comprises a 120° sector of phragmocone with a maximum preserved whorl height of 17.7 mm. Coiling is moderately evolute, the umbilical seam notched to accommodate the ventrolateral tubercles of the preceding whorl. The umbilicus is low, with a broadly rounded shoulder that merges with the broadly rounded inner flanks. The intercostal whorl section is depressed oval, the costal whorl section depressed angular-trapezoidal, with the greatest breadth at the umbilical spines. There are traces of four strong, blunt, conical umbilical spines on the fragment. They give rise to groups of three narrow prorsiradiate ribs, which loop in pairs to strong ventral clavi. Occasional ribs intercalate between the looped pairs. The venter is very broad, convex and smooth. The strong clavi are alternate across the venter.

Discussion
The type material of *Callihoplites tetragonus* SEELEY, 1865 (p. 243) comes from the *Mortoniceras fallax* Zone, and is substantially older than the type material, Swiss and Kolbay specimens referred to *C. dorsetensis*. Furthermore, none of the highly variable *fallax* Zone *tetragona* from the uncondensed Strépy fauna, southern Belgium (KENNEDY *et al.*, 2008, p. 38, pl. 1, figs 1-18, pl. 2, figs 1-26; pl. 3, figs 1-24; pl. 4, figs 1-5; pl. 5, figs 1-6, 10-17) show the combination of ribbing, strong ventral tubercles and broad, smooth, convex venter. SPATH (1928, p. 212) had already noted this last feature; accordingly, *dorsetensis* is afforded specific status here.

Occurrence
Upper Albian, *perinflatum* Zone, southern England, southeast France, Switzerland and Kolbay, Kazakhstan.

Genus and subgenus *Arrhaphoceras* WHITEHOUSE, 1927

Type species: *Ammonites woodwardi* SEELEY, 1865, p. 236, pl. 11, fig. 3, by original designation (WHITEHOUSE, 1927, p. 109).

Arrhaphoceras (*Arrhaphoceras*) *subtetragonum* SPATH, 1928
Pl. 1, Figs 1-22

1859 – *Ammonites Raulinianus* D'ORB. – PICTET & CAMPICHE, p. 226, pl. 29, figs 3, 5.
1927 – *Callihoplites tetragonus* SPATH *non* SEELEY – SPATH, p. 204.
1928 – PICTET & CAMPICHE's figs 3 and 4 – SPATH, p. 213.
*1928 – *Arrhaphoceras subtetragonum* SPATH, p. 253 (*pars*).
1968 – *Arrhaphoceras? subtetragonum* SPATH – RENZ, p. 33, pl. 3, fig. 10; text-figs 11g, h, 12c.
1968 – *Arrhaphoceras variabile* RENZ, p. 34, pl. 3, figs 8, 9; text-figs 11f, 12b.

Type
The holotype, by original designation, is no. 39866 in the collections of the Musée géologique, Lausanne, the original of PICTET & CAMPICHE (1859, p. 226, pl. 29, fig. 5), refigured by RENZ (1968, pl. 3, fig. 10; text-figs 11g, h, 12c), from La Vraconne near Sainte-Croix, Kanton Waadt, Switzerland.

Material
Twelve specimens, OUM KY 3826-3837, from fossil horizon 2 in the Kolbay section, upper Albian, *perinflatum* Zone.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KY 3831	16.4 (100)	10.4 (64,4)	7.8 (47,6)	1.33	3.5 (21,3)
KY 3832	18.8 (100)	11.1 (59,0)	9.5 (50,5)	1.17	4.0 (21.3)
KY 3834	19.3 (100)	9.9 (51,3)	11.4 (59,1)	0.86	3.4 (17,6)
KY 3929c	33.7 (100)	19.9 (59.1)	16.0 (47.5)	1.24	9.1 (27.0)
KY 3828c	41.2 (100)	24.1 (58.5)	19.2 (46.6)	1.26	11.7 (28.4)
KY 3827	42.0 (100)	28.3 (67.4)	20.7 (49.3)	1.37	11.8 (28.0)

Description
The assemblage consists of seven nuclei between 11 and 23 mm diameter (Pl. 1, Figs 1-10), and four larger, subadult individuals, 33-42 mm in diameter (Pl. 1, Figs 12-22). The nuclei vary from slightly compressed and feebly ornamented (OUM KY 3834; see Pl. 1, Figs 7, 8), to depressed and more robustly ornamented (OUM KY 3830 and KY 3831; see Pl. 1, Figs 4-6, 10, 11). OUM KY 3834 has a whorl breadth to height ratio of 0.86. The umbilicus comprises 17.6% of the diameter, and is of moderate depth, with a feebly convex, outward-inclined wall and broadly rounded shoulder. The whorl section is ovoid, with feebly convex inner to mid-flanks, the outer flanks converging to the feebly convex venter. At the adapical end of the outer whorl, ornament consists of delicate crowded ribs, convex on the inner flank and concave on the outer. The ribs increase by branching

and intercalation, strengthen across the flanks and develop into delicate oblique ventral clavi that alternate across the smooth venter. As size increases, delicate, widely spaced umbilical bullae appear. They give rise to two or three prorsiradiate ribs, while additional short ribs intercalate between. The ribs strengthen across the flanks and are markedly concave on the outermost flank and ventrolateral shoulder, where they strengthen into long, oblique bullae. The venter is smooth between the alternating bullae. Robust nuclei have whorl breadth to height ratios of up to 1.33, the whorl section reniform. The umbilicus is deep and conical, with a convex, outward-inclined wall and broadly rounded shoulder. An estimated twelve coarse bullae perch on the umbilical shoulder. They give rise to pairs of coarse, feebly rursiradiate to feebly prorsiradiate, concave ribs, while additional ribs intercalate. All ribs bear oblique ventral bullae that alternate in position on either side of the venter. The bullae give rise to low prorsiradiate ribs that link to form an irregular obtuse ventral chevron (Pl. 1, Figs 6, 10).

The larger specimens fall into two distinct groups. OUM KY 3826 and KY 3829 (see Pl. 1, Figs 12-17) are wholly septate. In OUM KY 3829, the intercostal whorl section is depressed, rounded-trapezoidal, with the greatest breadth low on the flanks. The costal section is polygonal, the faces deeply concave between the tubercles. The umbilicus is deep, the umbilical seam notched to accommodate the umbilical tubercles of the previous whorl. The umbilical wall is markedly convex. There are ten or eleven conical, subspinose umbilicolateral tubercles on the outer whorl. At the adapical end of the outer whorl, the tubercles give rise to two or three straight, radial ribs that strengthen across the flanks and develop into near-transverse ventral bullae (Pl. 1, Fig. 12). These alternate on either side of the venter, across which they are irregularly linked in an extremely obtuse chevron. As size increases, the flank ribs broaden and efface, zigzagging between rapidly strengthening ventral tubercles that rapidly develop first into feebly clavate to conical tubercles, and then into massive ventrolateral horns, the venter deeply concave in costal section between. The horns alternate in position and are linked by low, broad, obscure swellings (Pl. 1, Fig. 14). OUM KY 3826 (Pl. 1, Figs 15-17) has much stronger ribs, the ventral chevron less obtuse at the adapical end of the outer whorl (Pl. 1, Fig. 15), the looping and zigzagging of flank ribs between umbilicolateral bullae and ventrolateral tubercles more conspicuous (Pl. 1, Fig. 16). The ventral tuberculation shows the same progressive transformation as in the previous specimen. Of the second group of specimens, OUM KY 3828 (Pl. 1, Figs 18, 19) is a more compressed individual, in which the ribs dominate over the tubercles, looping and zigzagging between umbilicolateral and ventrolateral tubercles. The ventrolateral tubercles do not become spinose as in the previous specimens, and this individual forms a link to OUM KY 3827 (Pl. 1, Figs 20-22). Here, the ornament of the early whorls and the adapial part of the outer whorl of the previous specimens extends to a much larger diameter (compare Pl. 1, Figs 13, 16 with Pl. 1, Fig. 22). Ribs thus predominate over tubercles (Pl. 1, Fig. 21), and the venter has the same distinctive ribs and chevron (compare Pl. 1, Figs 12, 15 with Pl. 1, Fig. 22). It is tempting to regard OUM KY 3826 and KY 3829 as subadult microconchs and OUM KY 3827 and KY 3828 as subadult macroconchs, but in the absence of adult body chambers, this can only be speculation.

Discussion

OUM KY 3826 and KY 3829 have the ventral ornament typical of *Arrhaphoceras* on their early whorls, while this type of ornament extends throughout OUM KY 3827 (compare *e.g.*, RENZ, 1968, pl. 3, figs 1b, 2b, 3b). The first two specimens then develop tuberculation and ventral ornament like that of much earlier *Callihoplites tetragonus* (see *e.g.*, KENNEDY *et al.*, 2008, pl. 1, figs 5, 13; pl. 2, figs 3, 11). They thus belong to the group of species referred to as *Arrhaphoceras*? by RENZ (1968). OUM KY 3828 closely resembles the holotype of *A. subtetragonum*, refigured by RENZ (1968, pl. 3, fig. 10). Other specimens most closely resemble *A. variabile* RENZ, 1968 (p. 34, pl. 3, figs 8-10; text-figs 11f, 12b), which is regarded as a synonym.

Occurrence

Upper Albian, *perinflatum* Zone, Switzerland and Kolbay, Kazakhstan.

Family Placenticeratidae HYATT, 1900
Genus *Placenticeras* MEEK, 1876

Type species: *Ammonites placenta* DEKAY, 1828, p. 278, by original designation (MEEK, 1876, p. 462).

Discussion

A feature of the late Albian and Cenomanian ammonite faunas of Kazakhstan is the abundance of early members of the family Placenticeratidae. Russian authors introduced a series of genera and numerous specific names for this material, largely based on sutural characteristics, together with details of ornament:

Anaplacenticeras ILYIN, 1959, *Karamaiceras* SOKOLOV, 1967, *Turkmenites* ILYIN, 1975, *Kopetdagites* ILYIN, 1975, *Mediasiceras* ILYIN, 1975 and *Beschtubites* ILYIN, 1975. For a comprehensive list of species, and translations of generic diagnoses, reference is made to KLINGER & KENNEDY (1989). MARCINOWSKI (1980), KENNEDY & WRIGHT (1983) and KLINGER & KENNEDY (1989) successively revised these taxa, leading to the view that all of these (with others) could be accommodated in a long-ranging, slowly evolving *Placenticeras*.

Placenticeras kolbabajense (SOKOLOV, 1967)
Figs 5-6; Pl. 2, Figs 1-17; Pl. 3, Figs 1-14; Pl. 5, Figs 4-6; Pl. 8, Figs 17-18

*1967 – *Karamaiceras kolbajense* SOKOLOV, p. 138, figs a-d.
1967 – *Karamaiceras kolbajense* SOKOLOV – MIRZOYEV, p. 66, fig. 2c.
1983 – *Karamaiceras kolbajense* SOKOLOV – KENNEDY *in* JUIGNET *et al.*, p. 200, pl. 1, figs 13-15; text-fig. 7.

Type
The holotype, by original designation, is the original of SOKOLOV (1967, figs a, b), from the upper Albian of Kolbay. The specimen is probably from fossil horizon 2 of the present account; upper Albian, *perinflatum* Zone.

Material
Fifteen specimens, OUM KY 3861-3864 and KY 3876-3886 from fossil horizon 2 in the Kolbay section, upper Albian, *perinflatum* Zone.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KY 3879	38.4 (100)	10.0 (26,1)	22.7 (59.1)	0.44	5.0 (13,0)
KY 3883	48.3 (100)	12.7 (26,3)	25.6 (53,0)	0.50	6.7 (13.9)
KY 3880	49.4 (100)	13.8 (27,9)	26.4 (53,4)	0.52	7.0 (14,2)
KY 3885	50.7 (100)	13.4 (26.4)	27.5 (54.2)	0.48	7.7 (15.2)
KY 3868	55.4 (100)	15.5 (28.0)	30.9 (55.8)	0.50	7.8 (14.1)
KY 3882	56.2 (100)	14.5 (25.8)	30.9 (55.0)	0.47	8.0 (14.2)
KY 3884	58.2 (100)	16.6 (28.5)	31.8 (54.6)	0.52	7.1 (12.2)
KY 3881	62.2 (100)	19.3 (31.0)	33.7 (54.2)	0.57	8.7 (14.0)
KY 3877	71.7 (100)	18.7 (26.0)	39.6 (55.2)	0.47	9.0 (12.6)
KY 3876	90.7ic (100)	31.8 (35.0)	44.5 (49.0)	0.71	17.3(19.1)
	at69.0 (100)	20.5 (29.7)	34.8 (50.4)	0.59	11.2 (16.2)

Description
All but two of the specimens consist of phragmocone only. Coiling is very involute, the shallow, crater-like umbilicus comprising 7.8-9% of the diameter. The low umbilical wall is flattened and inclined outwards. The umbilical shoulder is very narrowly rounded. The whorl section is compressed, with a whorl breadth to height ratio that varies from 0.47 to 0.57. The greatest breadth is just outside the umbilical shoulder. The inner flanks are feebly convex, the outer flanks flattened and convergent. The ventrolateral shoulder is sharp, the very narrow venter concave between the shoulders. Internal moulds are initially virtually smooth to a diameter of approximately 30-40 mm. Where shell is preserved, it bears dense, crowded falcoid growth lines and striae that are straight and prorsiradiate on the inner flank, curved backwards and concave on the outer flank, and projected forwards to the ventrolateral shoulder. As diameter increases, distant falcoid ribs appear. These are weak and straight on the inner flank, but strengthen markedly

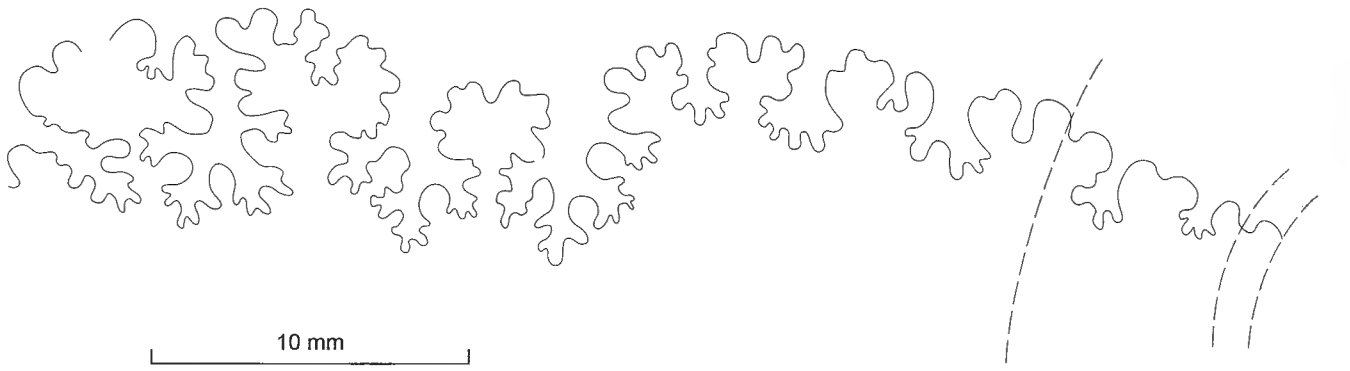

Fig. 5 – Partial external suture of *Placenticeras kolbajense* (SOKOLOV, 1967) (OUM KY 3876).

on the outer flank into broad concave crescents that decline and efface close to the ventrolateral shoulders. The ventrolateral shoulders are sharp and entire in most specimens; some show feeble undulations and the development of barely detectable incipient clavi corresponding to the flank ribs. An umbilical bulla appears at the greatest preserved diameter in OUM KY 3877 (Pl. 3, Fig. 10). The presence of this tubercle on this compressed phragmocone connects these specimens to OUM KY 3876, which is interpreted as an adult, with a 180° sector of body chamber preserved. The umbilicus comprises 16.3% of the diameter at the adapertural end of the phragmocone and is deeper than in the specimens described above, conical, with a flattened, outward-inclined wall. The umbilical shoulder is narrowly rounded. The intercostal whorl breadth to height ratio is 0.59; the greatest breadth is just outside the umbilical shoulder. There are five progressively strengthening, strongly prorsiradiate umbilical bullae on the final 180° sector of phragmocone. They give rise to pairs of feeble prorsiradiate straight ribs on the inner flank that strengthen into low, broad, concave ribs on the outer flank, where they are accompanied by occasional intercalated, concave ribs. There are small ventral clavi, more numerous than the flank ribs; they alternate in position across the venter. The body chamber shows markedly eccentric coiling, and the umbilical seam egresses, the umbilical diameter increasing to 19.1% of the diameter. The whorl breadth to height ratio increases from 0.59 at the adapical end of the body chamber to 0.71 at the adapertural end. There are two very strongly prorsiradiate umbilical bullae on the body chamber, each associated with a pair of low, near-effaced falcoid ribs. The ventrolateral clavi, well developed at the adapertural end of the body chamber, efface rapidly, and the venter broadens. The suture is shown in Figs 5 and 6, and is as described in detail by MIRZOYEV (1967).

Discussion

The numerous phragmocones are so different from the single adult that the initial impression is that two distinct species are present. The interpretation of the material as a single species with three distinctive growth stages is supported by the remarkable similarity of the ontogeny to that of the well-known *Placenticeras kaffrarium* ETHERIDGE, 1904 (see KLINGER & KENNEDY, 1989). In this Coniacian species, an early '*umkwelanense*' phragmocone stage is very compressed and near smooth, with fine falcoid or sickle-shaped striae and entire sharp ventrolateral shoulders, exactly as in the present species. The second, '*subkaffrarium*' growth stage is characterised by the appearance of umbilical tubercles that give rise to pairs of falcoid ribs, the edges of the venter become first crenulated and then develop alternating ventral clavi, as in the present species. Lateral tubercles appear, a feature not shown by the present species. The third, '*kaffrarium*' stage of *Placenticeras kaffrarium* sees the whorl breadth to height ratio increasing, the umbilical tubercles migrating outwards and ornament declining, the venter broadening and the umbilical seam egressing, changes that find parallels in our single adult.

With only one individual, it is not possible to determine with confidence which dimorph the present adult specimen, OUM KY 3876, represents. However, comparison with the not-dissimilar *P. kaffrarium* suggests that it may be a microconch.

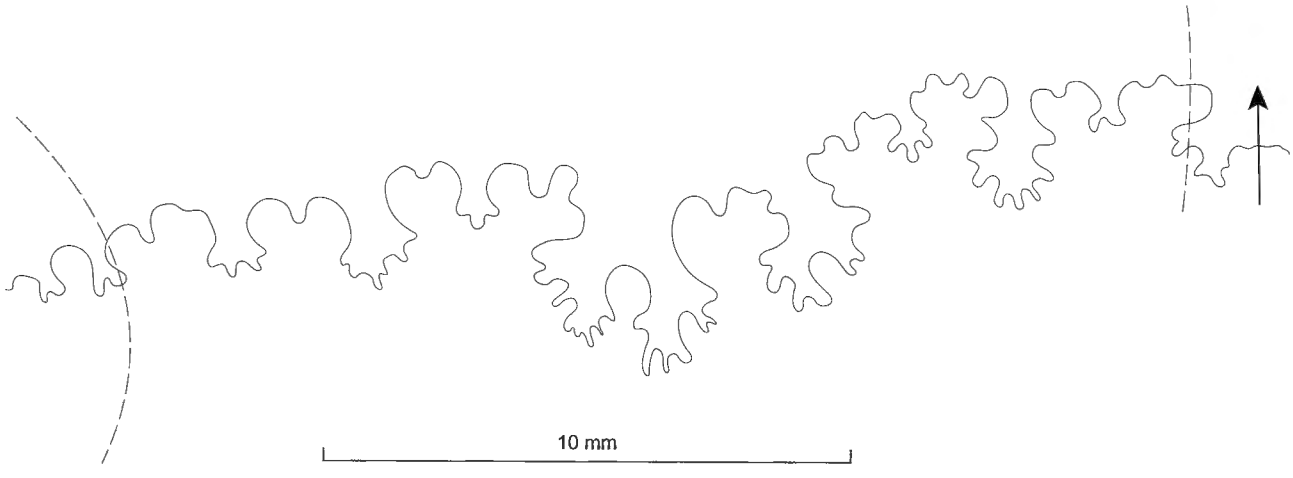

Fig. 6 – Partial external suture of *Placenticeras kolbajense* (SOKOLOV, 1967) (OUM KY 3885).

Occurrence
Upper Albian, *perinflatum* Zone, Kolbay, Kazakhstan. A similar age is presumed for the single known example from Sarthe (France).

Placenticeras mediasiaticum LUPPOV, 1963
Fig. 7; Pl. 4, Figs 1-8, 11-13; Pl. 5, Figs 1-3, 7-9

*1963 – *Placenticeras mediasiaticum* LUPPOV, p. 285, pl. 2, figs 10-12.
1975 – *Turkmenites gissarensis* ILYIN, p. 155, pl. 26, fig. 1; pl. 33, fig.1.
1980 – *Karamaites mediasiaticum* (LUPPOV, 1963) – MARCINOWSKI, p. 285, pl. 2, figs 10-12.
1984 – *Karamaites mediasiaticum* (LUPPOV) – SEYED-EMAMI *et al.*, p. 165, pl. 5, fig. 2; text-fig. 4a.
1996 – *Karamaites mediasiaticum* (LUPPOV) – MARCINOWSKI *et al.*, pl. 12, fig. 5.
1998 – *Placenticeras mediasiaticum* LUPPOV, 1963 – KAPLAN *et al.*, p. 109, pl. 9, figs 4, 5.

Type
The holotype, by original designation, is the original of LUPPOV (1963, text-fig. 2).

Material
Seven specimens, OUM KY 3814-3819 and KY 3897, from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone of fossil horizon 7 in the Kolbay section.

Dimensions

	D	Wb	Wh	Wb:Wh	U
KY 3817	39.9 (100)	12.5 (31,3)	21.3 (53.4)	0.59	6.0 (15,0)
KY 3987	38.6 (100)	10.9 (28,2)	19.4 (50,3)	0.56	7.2 (18.6)
KY 3818	50.0 (100)	14.0 (28,0)	26.5 (53,0)	0.53	7.5 (15)
KY 3819	55.2 (100)	14.4 (26.1)	28.5 (51.6)	0.51	- (-)
KY 3815	60.3 (100)	- (-)	30.6 (50.7)	- (-)	12.9 (21.3)
KY 3816	72.8 (100)	20.8 (28.6)	37.2 (51.1)	0.56	11.3 (15.5)

Description
These seven specimens exhibit considerable variation. At one extreme are gracile individuals such as OUM KY 3818 (Pl. 5, Figs 7, 8) and KY 3819 (Pl. 4, Figs 6-8). Coiling is very involute, the tiny umbilicus comprising 7.5% of the diameter, shallow, with a flattened, outward-inclined umbilical wall and very narrowly rounded umbilical shoulder. The whorls are very compressed, with whorl breadth to height ratios of 0.51 to 0.53, the greatest breadth just outside the umbilical shoulder. The inner flanks are broadly rounded, the middle and outer flanks flattened and converging to the sharp ventrolateral shoulders and very narrow, flat venter. The very weak ornament consists of falcoid growth lines and striae, straight and prorsiradiate on the inner flank, and flexed back and concave on the outer flank. OUM KY 3814 (Pl. 4, Figs 11-13) is of comparable morphology to a diameter of 17 mm, at which point delicate prorsiradiate umbilical bullae appear, which increase progressively in strength as diameter increases. There are nine bullae on the outer whorl of this phragmocone at a diameter of 72.8 mm. There is a very faint ornament of falcoid ribs that broaden progressively across the flanks. The ventrolateral shoulders are initially sharp and entire, but as size increases they become first crenulated, and then ventral clavi appear and alternate in position across the venter. OUM KY 3817 (Pl. 5, Figs 1-3) is a more robustly ornamented variant, 39.9 mm in diameter. Umbilical bullae are already present from the beginning of the outer whorl. They give rise to pairs of straight prorsiradiate ribs on the inner flank that strengthen and are concave on the outer flank. Additional ribs intercalate and all ribs terminate in small ventrolatral clavi. OUM KY 3987 (not figured), 41.7 mm diameter, shows comparable but stronger ornament throughout the outer whorl. OUM KY 3816 (Pl. 4, Figs 4, 5) is a stout

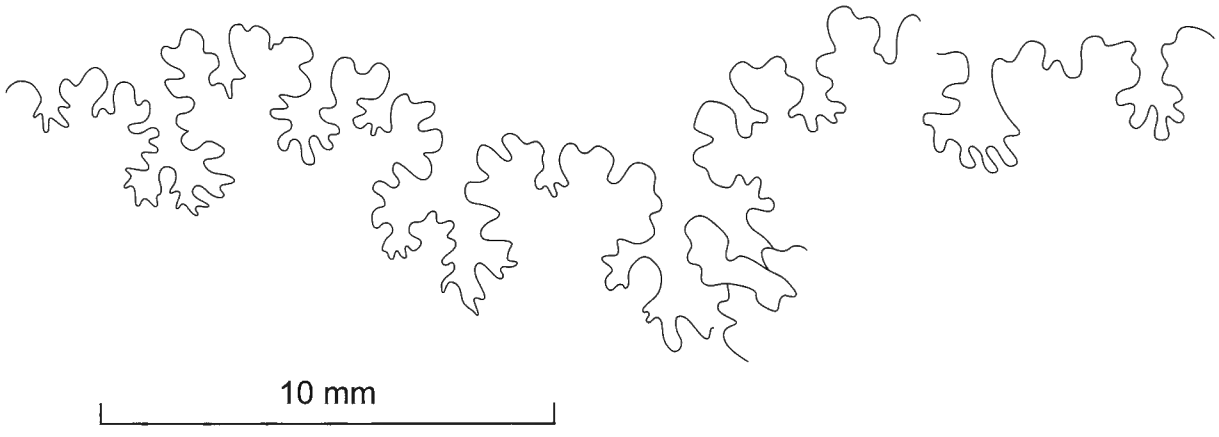

Fig. 7 – Partial external suture of *Placenticeras mediasiaticum* LUPPOV, 1963 (OUM KY 3816).

fragment with a whorl breadth to height ratio of 0.75, strong umbilical bullae and ventrolateral clavi but low, weak to obsolete broad flank ribs. The final specimen, OUM KY 3814 (Pl. 4, Figs 1-3) is interpreted as the robust variant of the species. Coiling is more evolute than in the gracile form, with the umbilicus comprising 21.3% versus 15% of the diameter, deeper and with a much more broadly rounded umbilical shoulder. The whorls are more inflated, with a whorl breadth to height ratio of 0.69 *vs* 0.51-0.53. There are an estimated nine progressively coarsening, strongly prorsiradiate umbilical bullae on the outer whorl at a diameter of 60 mm. They give rise to one or two coarse, low, broad straight prorsiradiate falcoid ribs, straight on the inner flank,and coarser and concave on the outer flank, where additional ribs intercalate to give a total of fourteen ribs and associated coarse ventrolateral clavi on the adapertural half of the outer whorl.

The suture line (Fig. 7) is as described and illustrated by LUPPOV (1963, text-fig. 2; see also MARCINOWSKI, 1980, text-fig. 13c), with six lateral saddles and lobes.

Discussion

This small collection raises more problems than it resolves. Interpretation as a single species exhibiting intraspecific variation like that shown by later species of *Placenticeras* (KLINGER & KENNEDY, 1989) is the approach adopted here. The gracile variants (Pl. 4, Figs 6-8, 11-13; Pl. 5, Figs 7-9) correspond to *Placenticeras mediasiticum* of previous authors. OUM KY 3816 resembles the holotype of *Placenticeras grossouvrei* SEMENOV, 1899 (p. 97, pl. 2, fig. 5). Robust variants such as OUM KY 3815 (Pl. 4, Figs 1-3) correspond to *Placenticeras* [*Turkmenites*] *gissarensis* ILYIN, 1975 (p. 155, pl. 31, fig. 1; pl. 33, fig. 1). Both MARCINOWSKI (1980) and SEYED-EMAMI *et al.* (1984) described co-occurring 'species' of *Placenticeras* from the Cenomanian of Crimea and the Iranian part of Kopet-Dag, respectively. I have little doubt that study of larger contemporaneous collections will confirm wide intraspecific variation in Cenomanian *Placenticeras*, spanning species noted here and others described by ILYIN (1975). The present material points to this conclusion but does not demonstrate it unequivocally. Accordingly, the name *mediasiaticum* is used at this time, given the fragmentary nature of the specimen that resembles the earlier described *grossouvrei*.

Occurrence

Lower and middle Cenomanian. The geographic distribution extends from Mangyshlak (Azhirektoy, Kolbay) to the Kopet-Dag in both Turkmenistan and Iran, possibly the Emba region of Kazakhstan and Crimea (Ukraine).

Family Schloenbachiidae PARONA & BONARELLI, 1897
Genus *Schloenbachia* NEUMAYR, 1875

Type species: *Ammonites varians* J. SOWERBY, 1817, p. 169, pl. 176, by subsequent designation of H. DOUVILLÉ (1890, p. 290).

Schloenbachia varians (J. SOWERBY, 1817)
Pl. 5, Figs 10-12, 14, 15; Pl. 6, Figs 3, 6-13

*1817 – *Ammonites varians* J. SOWERBY, p. 169 (*pars*), pl. 176.
1996 – *Schloenbachia varians* (J. SOWERBY, 1817) – MARCINOWSKI *et al.*, pl. 4, fig. 1.
1998 – *Schloenbachia varians* (J. SOWERBY, 1817) – KAPLAN *et al.*, p. 107, pl. 10, fig. 12; pl. 11, fig. 5; pl. 12, figs 1-4, 6, 9, 12; pl. 13, figs 3-5, 14, 15; pl. 14, figs 1-21; pl. 15, figs 1-13; pl. 16, figs 1-14 (with full synonymy).
1999 – *Schloenbachia varians* (J. SOWERBY, 1817) – GALE *et al.*, pl. 1, figs 1, 2, 12-15.

Type

Lectotype, by subsequent designation of SPATH (1938, p. 544), is BMNH 43962b, the original of J. SOWERBY (1817, pl. 176, top figure), refigured by KENNEDY & HANCOCK (1978, pl. 3, fig. 1). It is from the Lower Chalk at an unknown locality in southern England.

Material

OUM KY 3820-3825, from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone of fossil horizon 7 in the Kolbay section.

Discussion

Study of large collections of early Cenomanian *Schloenbachia* reveal a very wide range of continuous morphological variation in which very different end members are linked by a complete gradation of intermediaries. This variation was most recently discussed by KAPLAN *et al.* (1998, p. 107; see also *e.g.*, KENNEDY *et al.*, 1979; KENNEDY & JUIGNET, 1984; MARCINOWSKI, 1983; THOMEL, 1992). It is useful to be able to give names to these intraspecific variants and the term 'forma' is used here. Populations of *Schloenbachia varians* thus vary from compressed individuals with delicate growth lines, lirae and riblets that correspond to forma *subplana* MANTELL, 1822 (p. 166, pl. 21, fig. 2 = forma *intermedia* MANTELL, 1822, p. 166, pl. 21, figs 5, 7), individuals with well-differentiated ribs

and delicate umbilical and inner lateral and stronger ventrolateral tubercles that correspond to forma *tollotiana* PICTET, 1847 (p. 109, pl. 10, fig. 5 = forma *subvarians* SPATH, 1926b, p. 430, based on *Ammonites varians* var. *intermedia* SHARPE, 1853, p. 23, pl. 8, fig. 7, *non* MANTELL); those with tubercles more prominent, corresponding to forma *subtuberculata* SHARPE, 1853 (p. 22, pl. 8, figs 5, 6) and *varians sensu stricto* (J. SOWERBY, 1817, pl. 176, top figure, refigured by KENNEDY & HANCOCK, 1978, pl. 3, fig. 1) and the strongly tuberculate forma *ventriosa* STIELER, 1922 (p. 31, based on *Ammonites coupei* var. *inflata* SHARPE, 1853, p. 24, pl. 8, fig. 1).

With this approach in mind, OUM KY 3825 (Pl. 6, Fig. 3) and OUM KY 3820 (Pl. 6, Figs 6-8) correspond to forma *tollotiana*. OUM KY 3824 (Pl. 5, Figs 14, 15) is a passage form between forma *tollotiana* and forma *subtuberculata*. OUM KY 3821 (Pl. 6, Figs 10, 11) is transitional between forma *subtuberculata* and *varians sensu stricto*, while OUM KY 3822 (Pl. 5, Figs 10-12) and OUM KY 3823 (Pl. 6, Figs 9, 12, 13) correspond to *varians sensu stricto*.

Occurrence

Widespread and common in the lower Cenomanian. *Schloenbachia* is a classic Boreal genus, with records from East Greenland, northern Ireland, western Scotland, England, Belgium, Germany, Switzerland, Poland and Ukraine. In France, the genus extends from the Boulonnais in the north as far south as the Alpes-Maritimes. There are records from the Mediterranean coast, at Cassis, but these are unfounded (KENNEDY, 1994). It is not known from the western Mediterranean, nor from Spain or points south. In Central Asia, there are records that extend east to Khrebet Pay-Koy on the Kara Sea coast, and as far southeast as the Mangyshlak Peninsula in Kazakhstan, Kopet-Dag in Turkmenistan and Iran north of the Zagros.

Superfamily Acanthoceratoidea DE GROSSOUVRE, 1894
Family Acanthoceratidae DE GROSSOUVRE, 1894
Subfamily Mantelliceratinae HYATT, 1903
Genus *Mantelliceras* HYATT, 1903

Type species: *Ammonites mantelli* J. SOWERBY, 1814, p. 199, by original designation (ICZN Specific Name No. 1634).

Mantelliceras saxbii (SHARPE, 1857)
Pl. 5, Fig. 13

*1857 – *Ammonites saxbii* SHARPE, p. 45, pl. 20, fig. 3.
1984 – *Mantelliceras saxbii* (SHARPE, 1857) – WRIGHT & KENNEDY, p. 121, pl. 23, fig. 4; pl. 32, figs 1-3; pl. 33, figs 1-4; pl. 34, figs 1-4; pl. 35, figs 1-5; pl. 36, figs 2, 3; pl. 39, fig. 1; text-figs. 25b-d, i; 26b; 28l-p (with full synonymy).
1998 – *Mantelliceras saxbii* (SHARPE, 1857) – KAPLAN *et al.*, p. 118, pl. 18, figs 1, 9; pl. 20, fig. 1; pl. 24, fig. 3; pl. 26, figs 7, 8, pl. 41, figs 2, 4 (with additional synonymy).

Type

Lectotype, by subsequent designation of WRIGHT & WRIGHT (1951, p. 38), is no. 7763 in the collections of the British Geological Survey, the original of SHARPE (1857, pl. 20, fig. 3), refigured by WRIGHT & KENNEDY (1984, pl. 35, fig. 2).

Material

OUM KY 3813, from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone, fossil horizon 7 in the Kolbay section.

Description

The specimen is a half whorl with an estimated original diameter of 86 mm. All but the whorl sector covering the adapertural five ribs is phragmocone. The umbilicus is blocked by sediment, but coiling appears to have been moderately involute. The costal whorl section is compressed, with the greatest breadth low on the flanks, the inner and middle flanks feebly convex and the outer flanks convergent. There are an estimated sixteen ribs on the outer half whorl. Primary ribs arise from feeble umbilical bullae and are straight and prorsiradiate across the flanks. Single intercalated ribs alternate regularly with the primaries and arise both low and high on the flanks. All ribs bear a well-developed outer ventrolateral clavus, linked across the venter by a strong, bar-like rib.

Discussion

This species was described in detail by KENNEDY & HANCOCK (1971), JUIGNET & KENNEDY (1976), WRIGHT & KENNEDY (1984) and KAPLAN *et al.* (1998). The early whorls, which are compressed, densely ribbed and generally lack a lateral tubercle, are easily distinguished from those of *M. mantelli* (J. SOWERBY, 1814) (WRIGHT & KENNEDY, 1984, p. 99, pl. 16, fig. 5; pl. 17, figs 1, 3; pl. 18, figs 1-3; pl. 19, figs 1-6; pl. 21, figs 2, 4; pl. 24, fig. 3), *M. cantianum* SPATH, 1926b

(WRIGHT & KENNEDY, 1984, p. 103, pl. 17, fig. 2; pl. 20, fig. 3; pl. 21, fig. 3; pl. 24, figs 1, 2, 4-6; pl. 25, figs 1-6; pl. 26, figs 1, 2, 4, 5; text-figs 25a, 27e-n, j-l), *M. lymense* (SPATH, 1926b) (WRIGHT & KENNEDY, 1984, p. 102, pl.10, fig. 9; pl. 22, figs 1-6; pl. 23, figs 1-3; pl. 31, figs 1, 2; pl. 36, fig. 4; text-figs 19, 24a, b, 26d, 28f-j), *M. picteti* HYATT, 1903 (WRIGHT & KENNEDY, p. 117, pl. 27, figs 1-5; pl. 28, figs 1-3; text-figs 25g, 27i, n-q), and *M. dixoni* SPATH, 1926b (WRIGHT & KENNEDY, p. 124, pl. 37, figs 1-6; pl. 38, figs 2-5; pl. 39, figs 2-5; pl. 40, figs 1-5; text-figs 21d-f, 22a-g, 23, 25e, j, 27m, r, s).

Mantelliceras couloni (D'ORBIGNY, 1850) (WRIGHT & KENNEDY, 1984, p. 119, pl. 21, fig. 1; pl. 23, figs 5, 6; pl. 29, figs 1-3; pl. 30, figs 1, 2; pl. 31, figs 3-5; pl. 36, fig. 5; text-figs 25f, h, 27a-d) is more difficult to separate when young, but generally has coarser inner ventrolateral tubercles and, in middle growth, prominent ventral clavi that increase in size through ontogeny, rather than declining, as in the present species. Some stout variants bear a feeble lateral tubercle. The present specimen compares well in ribbing style with the originals of WRIGHT & KENNEDY (1984, pl. 33, figs 3, 4 and pl. 34, fig. 4).

Occurrence

Mantelliceras saxbii ranges throughout the lower Cenomanian, but is common only in the middle of the substage, being represented by rather stout forms in the lower part of its range and by densely and flexuously ribbed forms in the upper part. It is widespread in southern England, the Boulonnais, Haute Normandie, Maine, Sarthe and Provence in France and also in northern Spain, Switzerland, Poland, Romania, Bulgaria, Kazakhstan, Iran north of the Zagros, North Africa, Angola, South Africa and Madagascar.

Mantelliceras lymense (SPATH, 1926b)
Pl. 5, Fig. 16

1926b – *Eucalycoceras lymense* SPATH, pp. 427, 431.
1984 – *Mantelliceras lymense* (SPATH, 1926b) – WRIGHT & KENNEDY, p. 102, pl.10, fig. 9; pl. 22, figs 1-6; pl. 23, figs 1-3; pl. 31, figs 1, 2; pl. 36, fig. 4; text-figs 19, 24a, b, 26d, 28f-j (with full synonymy).

Type

The lectotype, by subsequent designation of WRIGHT & KENNEDY (1984, p. 102), is the original of *Acanthoceras martimpreyi* (COQUAND, 1862) of PERVINQUIÈRE (1907, pl. 16, fig. 15), refigured by WRIGHT & KENNEDY as their text-fig. 24a, b. It is from north of Bargou, Tunisia.

Material

OUM KY 3812, from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone, fossil horizon 7 in the Kolbay section.

Description

The specimen is fragmentary, wholly septate, with an estimated original diameter of approximately 75 mm. Coiling is moderately involute, the umbilicus shallow, with a feebly convex wall and broadly rounded umbilical shoulder. The whorl section is slightly compressed, with a costal whorl breadth to height ratio of 0.84. The inner and middle flanks are feebly convex. The outer flanks converge to ventrolateral shoulders that are narrowly rounded in costal section, the venter between flattened and very feebly convex. Ornament is of numerous crowded, prorsiradiate, feebly flexuous to straight ribs, an estimated twenty on the adapical half of the outer whorl. The ventral region is only preserved at the adapertural end of the specimen. There are very feeble indications of outer ventrolateral tubercles.

Discussion

This specimen compares well with examples from the English Chalk (WRIGHT & KENNEDY, 1984, pl. 31, fig. 2) and from Cassis in southeast France (WRIGHT & KENNEDY, 1984, text-fig. 19). Distinctive features of *M. lymense* are the late acquisition of ventrolateral tubercles and the persistence of umbilical and outer ventrolateral tubercles only on the later whorls.

Occurrence

Lower Cenomanian, southern England, northern Ireland, France, Kolbay, Kazakhstan, Iran, Algeria, Tunisia and Madagascar.

Suborder Ancyloceratina WIEDMANN, 1966
Superfamily Turrilitoidea GILL, 1871
Family Anisoceratidae HYATT, 1900
Genus *Idiohamites* SPATH, 1925c

Type species: *Hamites tuberculatus* J. SOWERBY, 1818, p. 30, pl. 216, fig. 5, by original designation (SPATH, 1925c, p. 189).

Idiohamites dorsetensis SPATH, 1939
Pl. 7, Figs 1-13; Pl. 8, Figs 3-13, 19, 20

1861 – *Anisoceras alternatus* MANTELL – PICTET & CAMPICHE, p. 71, pl. 51, figs 1, 3.
1939 – *Idiohamites dorsetensis* SPATH, p. 596, pl. 62, figs 2, 3; pl. 63, figs 1, 9, 15; pl. 65, fig. 2; text-fig. 215 (with synonymy).
1942 – *Idiohamites dorsetensis* SPATH – BREISTROFFER, p. 62.
1968 – *Idiohamites dorsetensis* SPATH – RENZ , p. 70, pl. 11, figs 39, 40; pl. 12, figs 3, 4; text-figs 25d, f, 26a, b.
non 2007 – *Idiohamites dorsetensis* SPATH, 1939 – SZIVES, p. 111, pl. 27, fig. 10.

Type
The holotype, by original designation (SPATH, 1939, p. 62), is the original of PICTET & CAMPICHE (1861, pl. 51, fig. 1), refigured by RENZ (1968, pl. 12, fig. 4), no. 21266 in the collections of the Musée géologique, Lausanne, from the upper Albian *perinflatum* Zone of la Vraconne, Sainte-Croix, Kanton Waadt, Switzerland.

Material
Twenty-nine fragments, OUM KY 3839-3857 and KY 3858 (collective of twelve fragments), from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section.

Description
The material is entirely comprised of fragments, which can be reconstructed into a complete adult shell that consists of an initial planispire, of which at least one whorl was barely separated from the succeeding one, followed by a further whorl that becomes increasingly separated from the preceding one (Pl. 7, Fig. 1). This initial planispire is succeeded by a straight, slowly expanding shaft, a recurved crozier, and a second, shorter shaft that is set at an acute angle to the first (Pl. 6, Figs 19, 20). The presence of a small, complete adapertural body chamber fragment (Pl. 6, Figs 19, 20) and much larger body chamber fragments (Pl. 7, Figs 10-12) is taken as evidence of dimorphism, the former a microconch, the latter macroconchs. The early, coiled whorls (Pl. 7, Figs 1-4) have a compressed oval whorl section, with a whorl breadth to height ratio of 0.86 in OUM KY 3851. The rib index is 3-4. The ribs are weak to effaced and transverse on the dorsum, strengthening across the dorsolateral margin and flanks, where they are rursiradiate and markedly convex. They strengthen across the flanks and are strong and transverse on the venter. Ventral clavi are present on alternate ribs in some specimens (OUM KY 3839; see Pl. 7, Fig. 1; OUM KY 3856), in others, tuberculate ribs outnumber the non-tuberculate (OUM KY 3848; see Pl. 7, Figs 3, 4). The rib linking the tubercles may be subdivided into a pair of riblets that loop between the tubercles. The succeeding shaft is slightly compressed (costal whorl breadth to height ratio 0.94 in OUM KY 3842), ovoid in intercostal section, the dorsum more broadly rounded than the venter. The rib index is 3. The ribs are weak and transverse on the dorsum, feebly (OUM KY 3847; see Pl. 7, Fig. 13) to strongly prorsiradiate (OUM KY 3842; see Pl. 8, Figs 9-11) on the flanks, across which they strengthen progressively. Tuberculate and non-tuberculate ribs alternate more or less regularly. The tubercles may be spinose on the body chamber (OUM KY 3842; see Pl. 8, Figs 5, 6, 9-11). The rib direction changes from prorsiradiate to rursiradiate around the crozier, and is strongly rursiradiate on the final shaft (OUM KY 3844; see Pl. 8, Figs 19, 20). A variant referred to the species (OUM KY 3849; see Pl. 8, Figs 3, 4; KY 3844; see Pl. 7, Fig. 13) may have two non-tuberculate ribs between successive tuberculate ones. In some individuals a pair of riblets may link the tubercles across the venter (OUM KY 3840; see Pl. 7, Fig. 10). OUM KY 3843 (Pl. 8, Figs 7, 8) has strikingly differentiated coarse, tuberculate, and weak, non-tuberculate ribs on the crozier.

The suture is moderately incised with bifid lobes and saddles.

Discussion
The reconstructed shell form of *Idiohamites dorsetensis* is comparable to that of complete specimens of *Idiohamites elegantulus* SPATH, 1939, from Montlaux, Hautes-Alpes (France), recently described by KENNEDY & LATIL (2007, p. 170, pl. 8, figs 1-7; pl. 9, figs 1-3, 5-8). This is much more finely and evenly ribbed than *dorsetensis*, with a rib index of 5, and tiny ventral tubercles on all ribs in some specimens, and on alternate ribs in others.

Occurrence
Upper Albian, *perinflatum* Zone, southern England, Switzerland, southern France and Kolbay, Kazakhstan.

Genus *Algerites* PERVINQUIÈRE, 1910

Type species: *Algerites sayni* PERVINQUIÈRE, 1910, p. 47, pl. 10(1), figs 21-25, by original designation (PERVINQUIÈRE, 1910, p. 46).

Algerites ellipticus (MANTELL, 1822)
Pl. 8, Figs 1, 2

*1822 – *Hamites ellipticus* MANTELL, p. 122, pl. 23, fig. 9.
1995 – *Algerites ellipticus* (MANTELL, 1822) – WRIGHT & KENNEDY, p. 312, pl. 92, figs 4, 11; pl. 93, figs 2, 3, 9; pl. 94, figs 2, 5-7, 10-12; text-fig. 128a (with full synonymy).
?1998 – *Algerites* cf. *ellipticus* (MANTELL, 1822) – KAPLAN *et al.*, p. 184.

Type
The holotype, by monotypy, is BMNH 8611, from the lower Cenomanian Chalk Marl of Middleham (Ringmer, Sussex), the original of MANTELL (1822, pl. 23, fig. 9), refigured by WRIGHT & KENNEDY (1995, pl. 94, fig. 11).

Material
OUM KY 3811, from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone, fossil horizon 7 in the Kolbay section.

Description
The specimen is a 20.6 mm long fragment of body chamber with a maximum preserved whorl height of 11 mm and a costal whorl breadth to height ratio of 0.72. The whorl section is compressed oval, with the greatest breadth at mid-flank. The dorsum is smooth. The ribs arise on the dorsolateral margin and are prorsiradiate and feebly convex across the flanks. All ribs bear a row of rounded to feebly clavate ventral tubercles, linked across the venter by a coarse rib. The rib index is 5.

Discussion
Algerites ellipticus differs from *A. sayni* PERVINQUIÈRE, 1910 (p. 47, pl. 10(1), figs 21-25; see WRIGHT & KENNEDY, 1995, p. 312, pl. 94, fig. 1; text-figs 128d, 130a-i) in having a less compressed whorl section, coarser ribbing, fewer branching ribs and fewer constrictions.

Occurrence
Lower lower Cenomanian. Known from southern England, France, Poland, Kolbay, Kazakhstan, Iran and Algeria, and possibly the Münsterland Basin, Germany.

Family Baculitidae GILL, 1871
Genus and subgenus *Lechites* NOWAK, 1908

Type species: *Baculites gaudini* PICTET & CAMPICHE, 1861, p. 112, pl. 55, figs 5-9, by original designation (NOWAK, 1908, p. 350).

Lechites (*Lechites*) *moreti* BREISTROFFER, 1936
Pl. 8, Figs 14-16

1822 – *Baculites gaudini* PICTET & CAMPICHE, p.112 (*pars*), pl. 55, figs 10, 11 only.
1936 – *Lechites moreti* BREISTROFFER, p. 66.
1968 – *Lechites moreti* BREISTROFFER – RENZ, p. 81, pl. 16, figs 10, 12, 13; text-fig. 29a, i (with synonymy).
1979 – *Lechites gaudini moreti* BREISTROFFER, 1936 – SCHOLZ, p. 14, pl. 1, fig. 10; text-fig. 5c.
1995 – *Lechites gaudini moreti* BREISTROFFER, 1936 – LATIL, pl. 7, fig. 2.
2000 – *Lechites moreti* BREISTROFFER, 1936 – ARKADIEV *et al.*, p. 120, pl. 7, fig. 1.
2001 – *Lechites moreti* BREISTROFFER – WIEDMANN & OWEN, pl. 3, fig. e.
2007 – *Lechites* (*Lechites*) *moreti* BREISTROFFER, 1936 – KENNEDY & LATIL, p. 472, pl. 10, figs 3-5, 8, 9, 15.
2007 – *Lechites* (*Lechites*) *moreti* BREISTROFFER, 1936 – SZIVES, p. 117, pl. 22, figs 7, 8; pl. 27, figs 11, 17, 21 (with additional synonymy).

Type
The lectotype, by subsequent designation of RENZ (1968, p. 81), is the original of *Baculites gaudini* PICTET & CAMPICHE (1861, p.112 (*pars*), pl. 55, fig. 10), no. 40016 in the collections of the Musée géologique, Lausanne, refigured by RENZ (1968, pl. 16, fig. 10; text-fig. 29a, i), from the upper Albian of la Vraconne, Sainte-Croix, Kanton Waadt, Switzerland.

Material
OUM KY 3859, from the upper Albian *perinflatum* Zone, fossil horizon 2 in the Kolbay section.

Description
The specimen is an internal mould of a phragmocone 36.8 mm long, with a maximum preserved whorl height of 11.3 mm. The whorl section is subcircular, slightly compressed, with a whorl breadth to height ratio of 0.93. The whorls expand slowly. The surface of the mould is smooth, except for narrow constrictions, one in a distance equal to the whorl height. The constrictions are effaced on the dorsum, strengthen across the dorsolateral margin and are prorsiradiate and markedly convex on the flanks, and strong and transverse across the venter. The flanks are swollen between successive constrictions.

Suture with moderately incised rectangular, bifid lobes and saddles.

Discussion

Lechites (*L.*) *moreti* is immediately distinguished from other species of *Lechites* by the ornament of narrow constrictions with broad swollen areas of flank between, rather than the ribs more typical of the remaining species of the genus, which were fully discussed by RENZ (1968), WIEDMANN & DIENI (1969) and SCHOLZ (1979).

Occurrence

Upper Albian, *perinflatum* Zone; southern England, southeast France, Switzerland, Hungary, Kolbay, Kazakhstan, Spain, Sardinia and Algeria.

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Explanation of the plates

PLATE 1

Figs 1-22 – *Arrhaphoceras* (*Arrhaphoceras*) *subtetragonum* SPATH, 1928; 1-3, OUM KY 3835; 4-6, OUM KY 3831; 7-9, OUM KY 3834; 10, 11, OUM KY 3830; 12-14, OUM KY 3829; 15-17, OUM KY 3836; 18, 19, OUM KY 3828; 20-22, OUM KY 3827.

All specimens are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section; Figs 1-11 are x 2; Figs 12-22 are x 1.

PLATE 2

Figs 1-17 – *Placenticeras kolbajense* (SOKOLOV, 1967); 1-3, OUM KY 3879 ; 4-6, OUM KY 3882; 7-9, OUM KY 3883; 10-12, OUM KY 3881; 13, 14, OUMKY 3886; 15-17, OUM KY 3884.

All specimens are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section; all x 1.

PLATE 3

Figs 1-14 – *Placenticeras kolbajense* (SOKOLOV, 1967); 1-3, OUM KY 3885; 4-6, OUM KY 3880; 7, 8, OUM KY 3878; 9-11, OUM KY 3877; 12-14, OUM KY 3876.

All specimens are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section; all x 1.

PLATE 4

Figs 1-8, 11-13 – *Placenticeras mediasiaticum* LUPPOV, 1963; 1-3, OUM KY 3815; 4, 5, OUM KY 3816; 6-8, OUM KY 3819; 11-13, OUM KY 3814.

All specimens are from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone fauna of fossil horizon 7 in the Kolbay section; all x 1.

Figs 9-10, 14 – *Placenticeras kolbajense* (SOKOLOV, 1967); 9, 10, 14, OUM KY 3862.

Specimen from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section; x 1.

PLATE 5

Figs 1-3, 7-9 – *Placenticeras mediasiaticum* LUPPOV, 1963; 1-3, OUM KY 3817; 7-9, OUM KY 3818.
Figs 4-6 – *Placenticeras kolbajense* (SOKOLOV, 1967), OUM KY3863.
Figs 10-12, 14-15 – *Schloenbachia varians* (J. SOWERBY, 1817); 10-12, OUM KY 3822; 14, 15, OUM KY 3824.
Fig. 13 – *Mantelliceras saxbii* (SHARPE, 1857), OUM KY3813.
Fig. 16 – *Mantelliceras lymense* (SPATH, 1926b), OUM KY 3812.

The originals of Figs 1-3, 7-16 are from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone fauna of fossil horizon 7 in the Kolbay section. The original of Figs 4-6 is from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section; all x 1.

PLATE 6

Figs 1-2 – *Callihoplites dorsetensis* SPATH, 1928, OUM KY3838.
Figs 3, 6-13 – *Schloenbachia varians* (J. SOWERBY, 1817); 3, OUM KY 3825; 6-8, OUM KY 3820; 9, 12, 13, OUM KY 3823; 10, 11, OUM KY 3821.
Figs 4-5 – *Lepthoplites gracilis* SPATH, 1928, OUM KY3860.

The originals of Figs 1, 2, 4, 5 are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section, while the originals of Figs 3, 6-13 are from the lower lower Cenomanian *mantelli* Zone, *carcitanense* Subzone fauna of fossil horizon 7 in the Kolbay section; all x 1.

PLATE 7

Figs 1-13 – *Idiohamites dorsetensis* SPATH, 1939; 1, OUM KY 3839; 2, 3, OUM KY 3852; 4, OUM KY 3848; 5-7, OUM KY 3841; 8, 9, OUM KY 3846; 10-12, OUM KY 3842; 13, OUM KY 3849.

All specimens are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section. Figs 2-4, 8, 9 and 13 are x 2; Figs 1, 5-7 and 10-12 are x 1.

PLATE 8

Figs 1-2 – *Algerites ellipticus* (MANTELL, 1822), OUM KY 3811.
Figs 3-13, 19-20 – *Idiohamites dorsetensis* SPATH, 1939; 3, 4, OUM KY 3849; 5, 6, OUM KY 3850; 7, 8, OUM KY 3843; 9-11, OUM KY 3842; 12, 13, OUM KY 3851; 19, 20, OUM KY 3844.
Figs 14-16 – *Lechites moreti* BREISTROFFER, 1936, OUM KY 3859.
Ffigs 17-18 – *Placenticeras kolbajense* (SOKOLOV, 1967), OUM KY 3864.

The original of Figs 1, 2 is from the lower Cenomanian *mantelli* Zone, *carcitanense* Subzone fauna of fossil horizon 7 in the Kolbay section, while the originals of Figs 3-20 are from the upper Albian *perinflatum* Zone fauna of fossil horizon 2 in the Kolbay section. Figures 1 and 2 are x 2; Figs 3-20 are x 1.

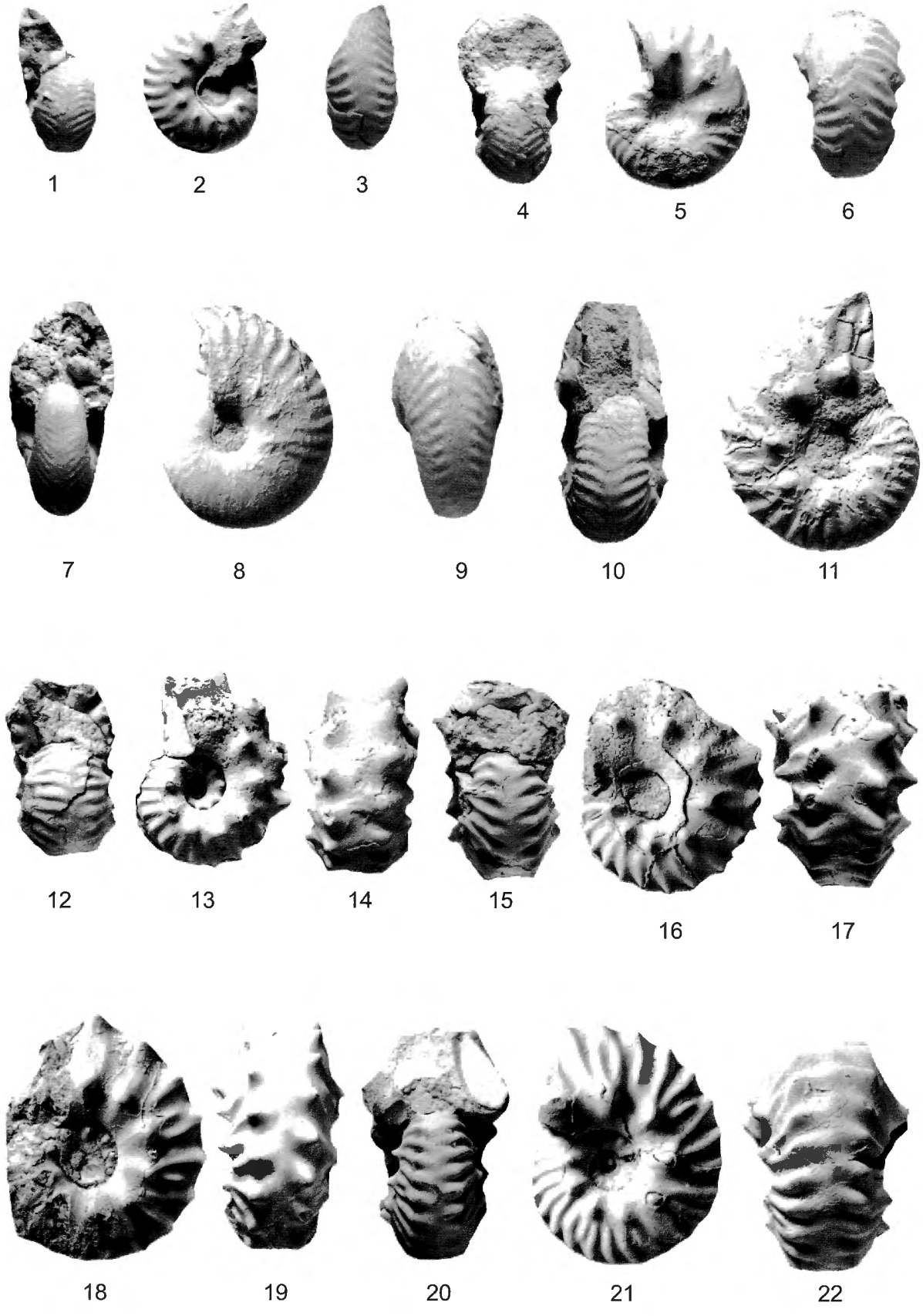
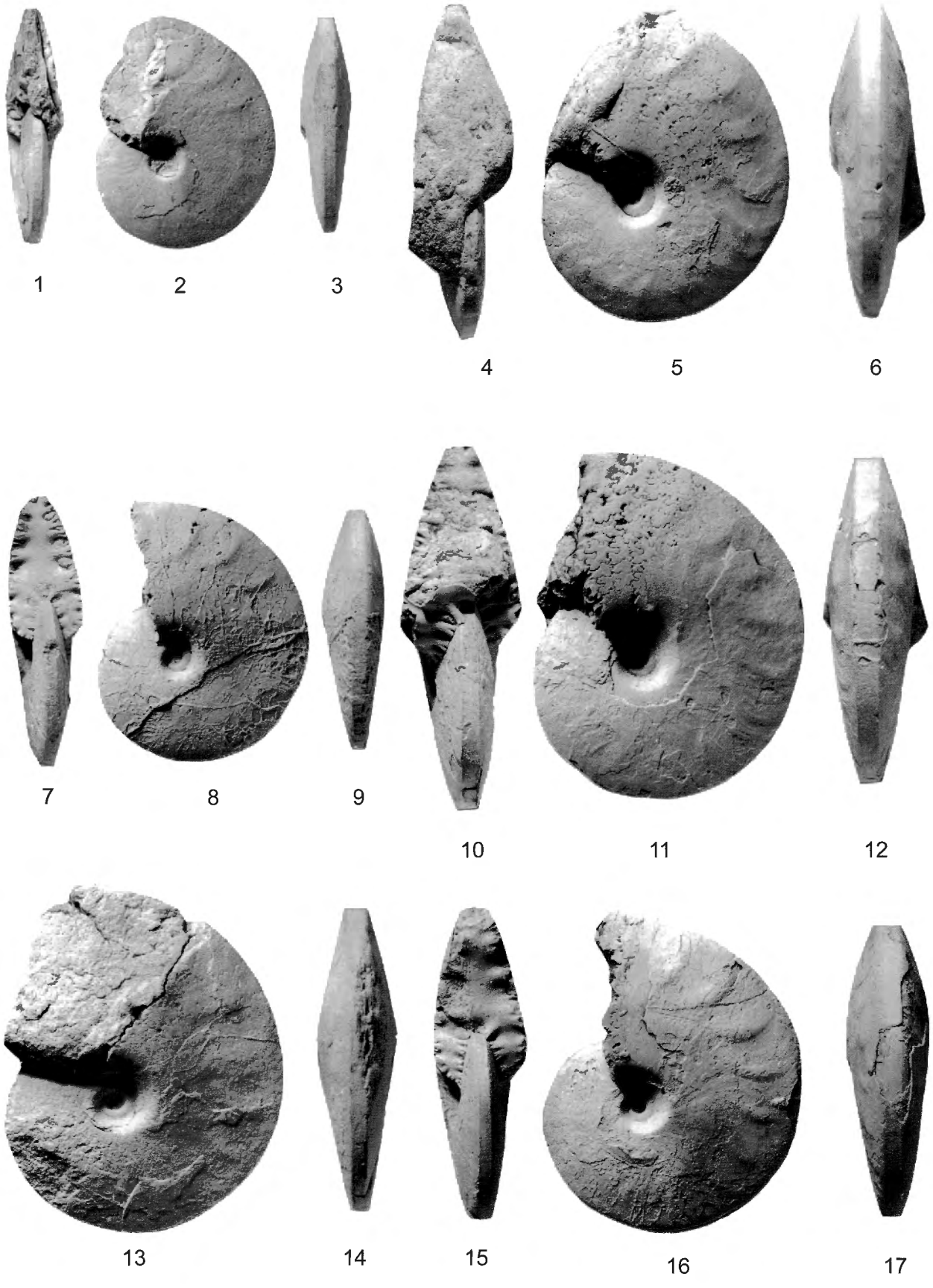


PLATE 1



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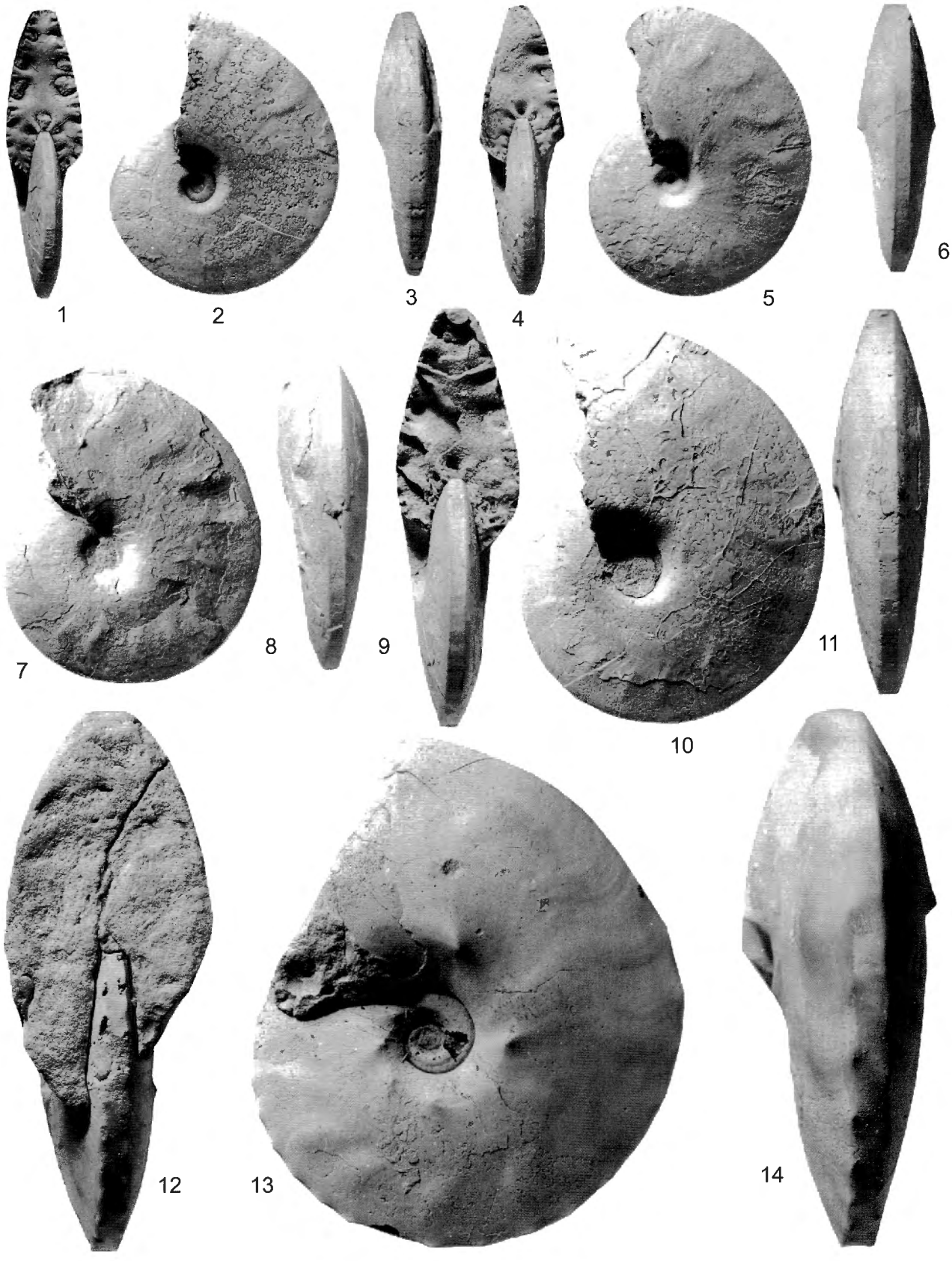

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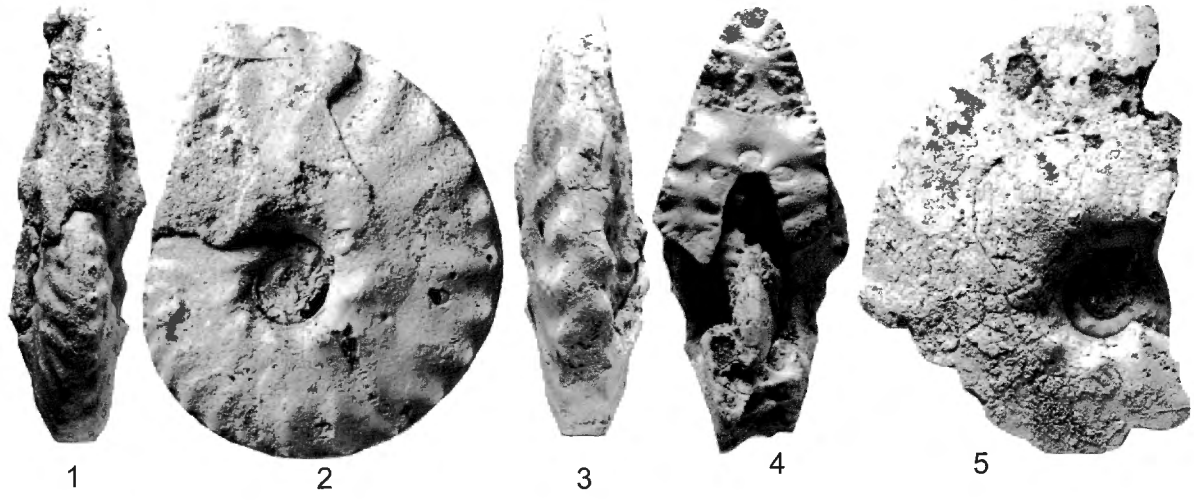

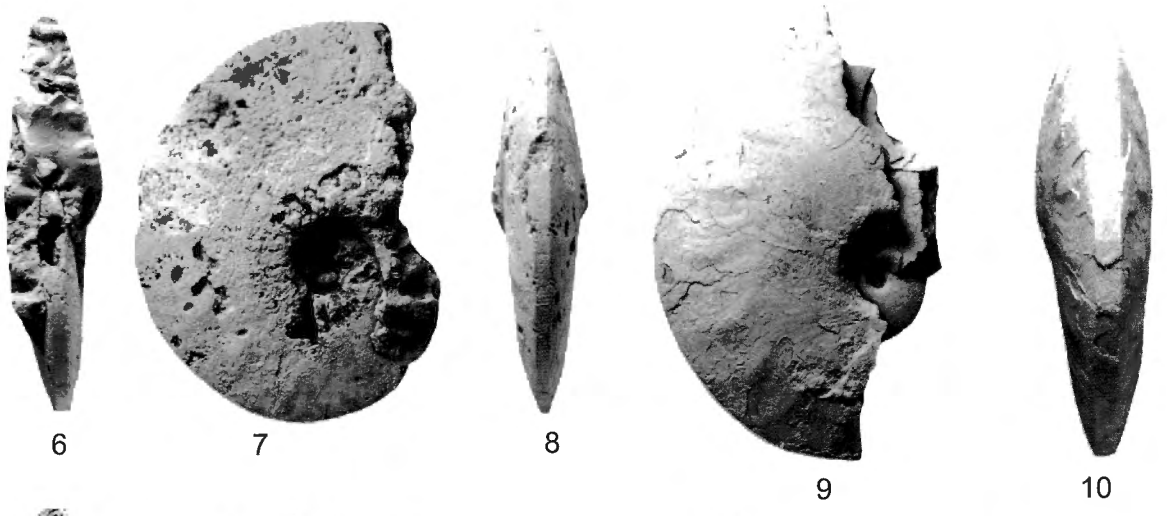

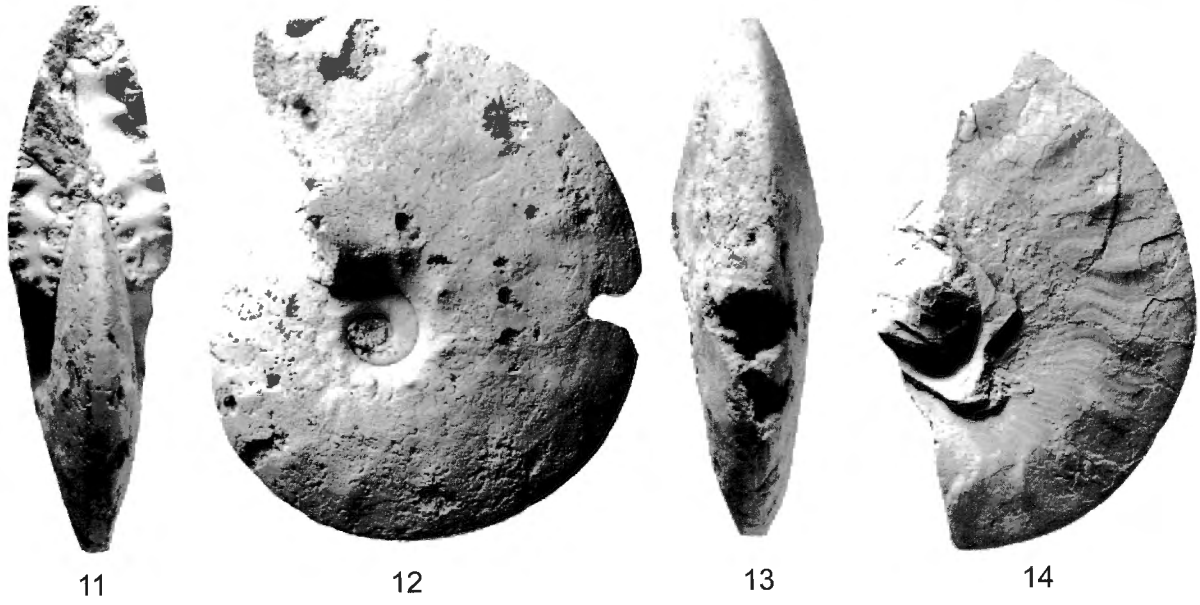

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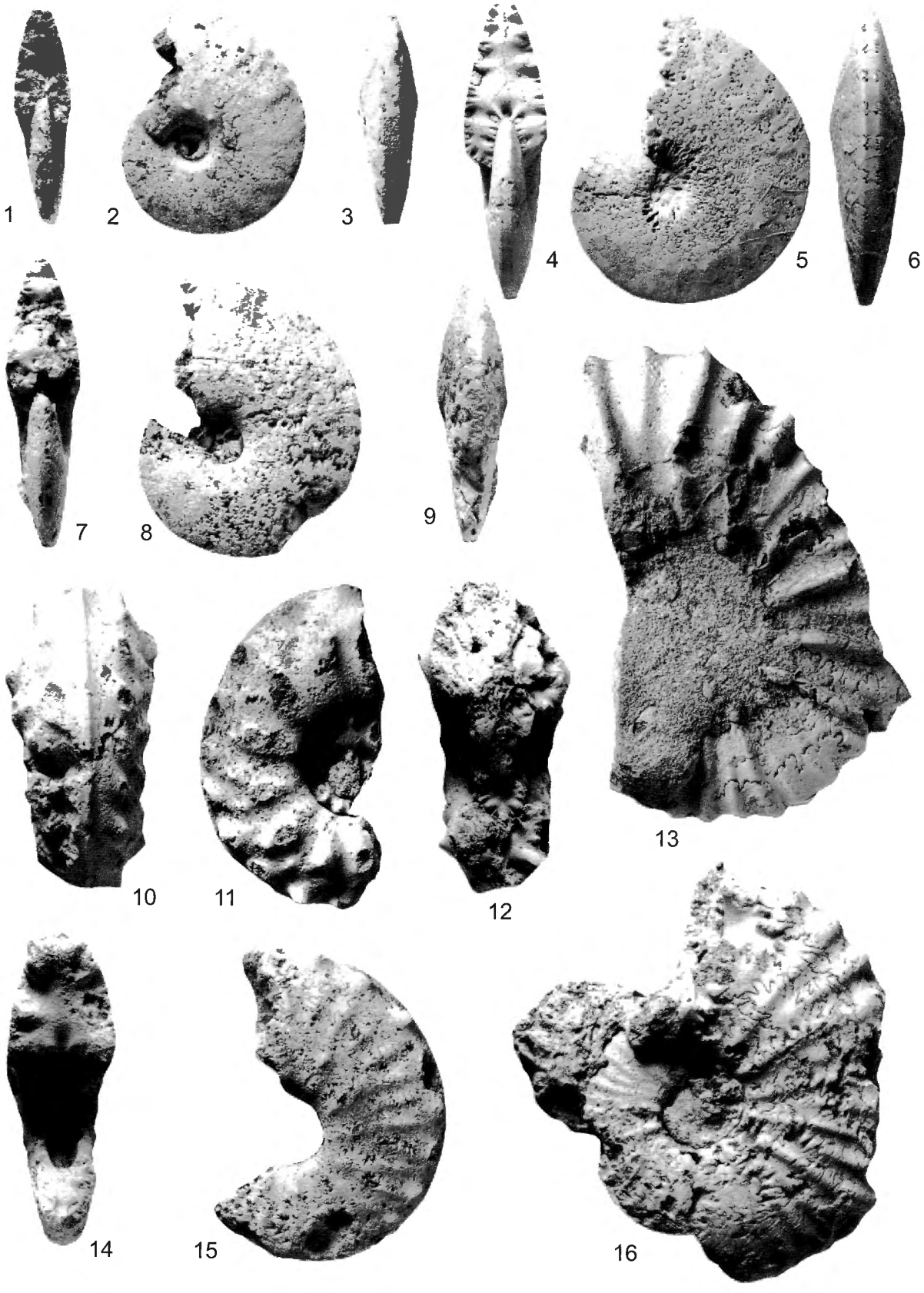

PLATE 5

PLATE 6

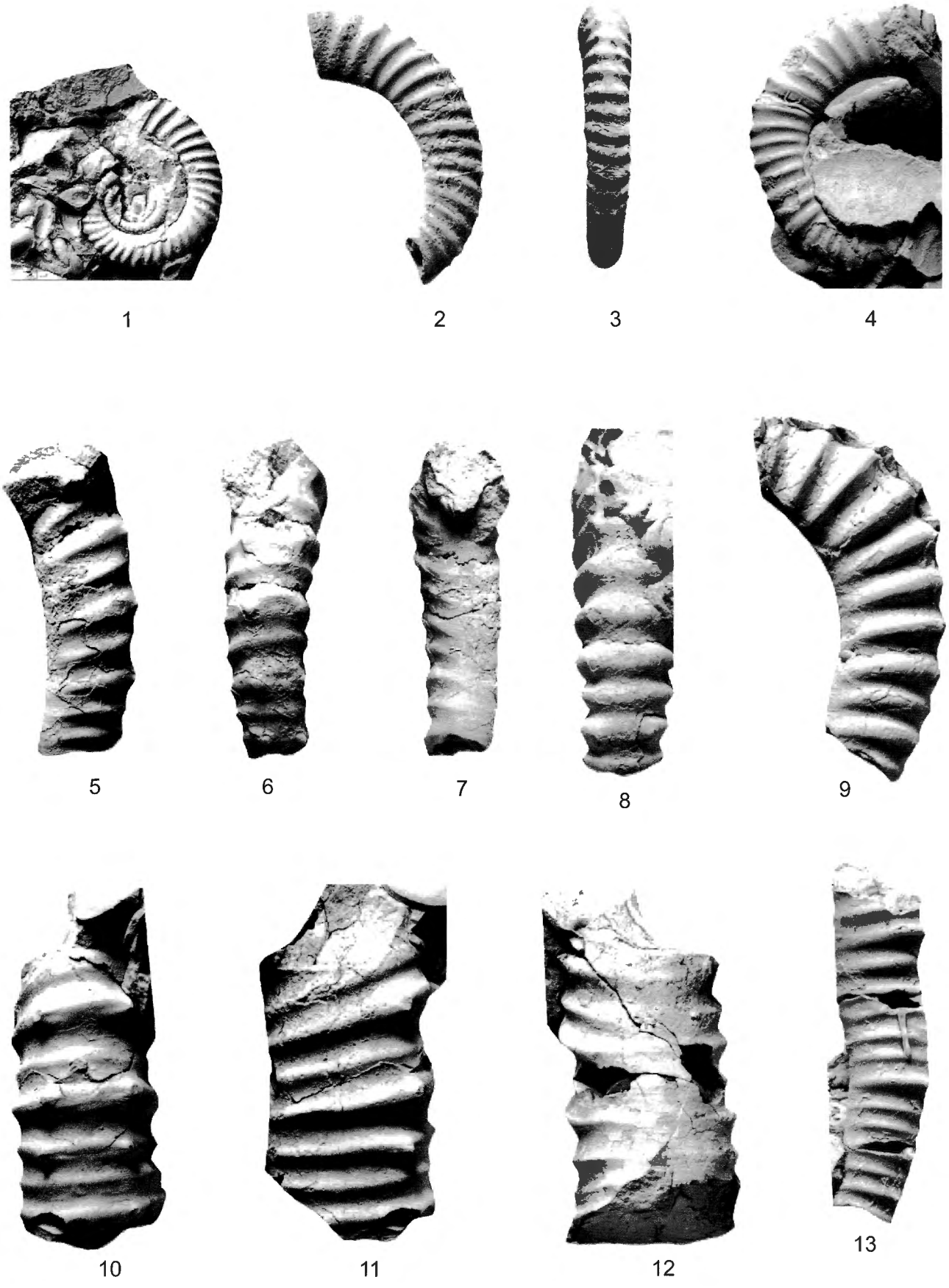

PLATE 7

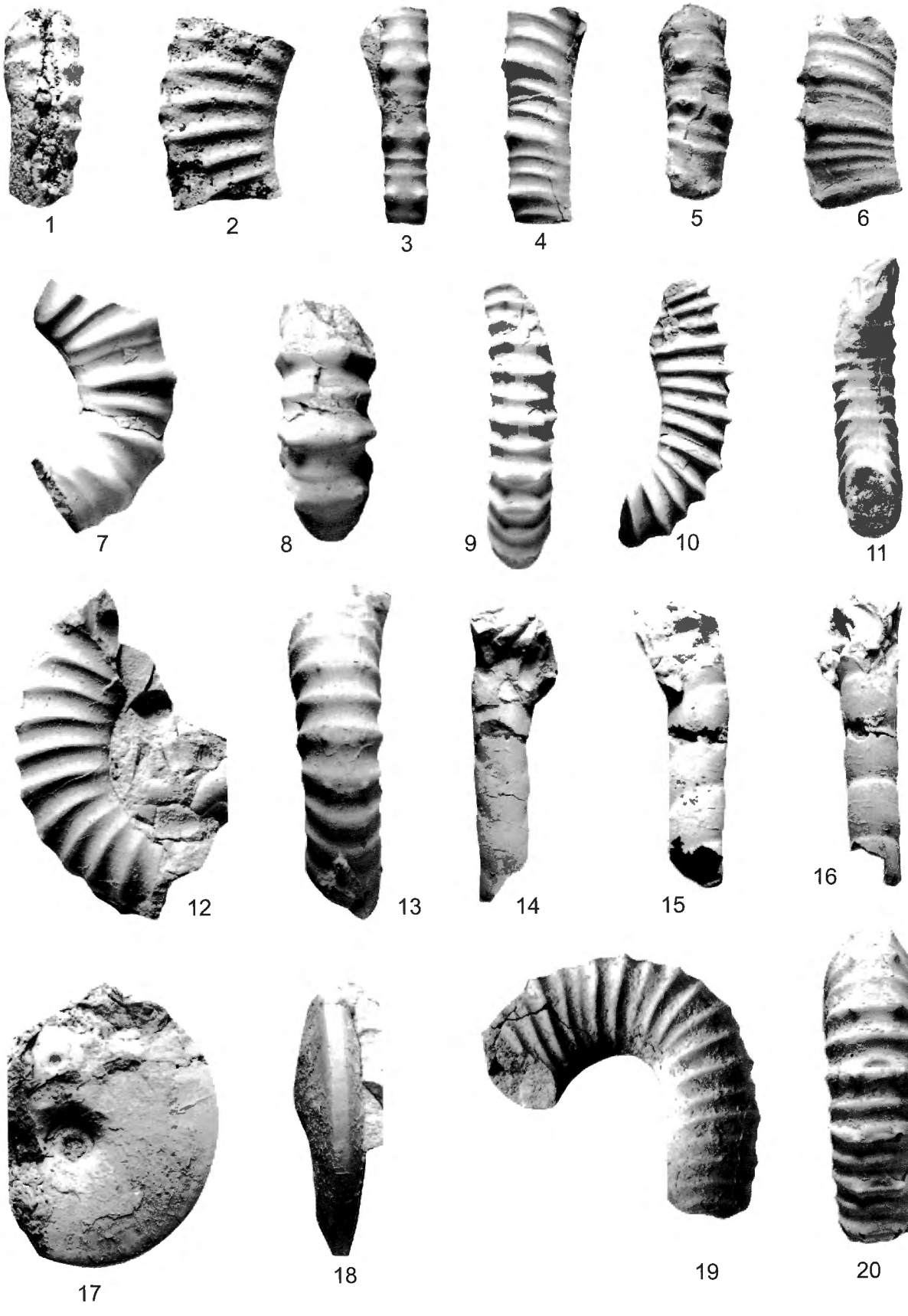

PLATE 8