

# Ammonites and inoceramids of the Middle–Upper Albian of Mangyshlak (western Kazakhstan); systematics, biostratigraphy and biogeography

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## ABSTRACT:

Kennedy, W.J. and Walaszczyk, I. 2025. Ammonites and inoceramids of the Middle–Upper Albian of Mangyshlak (western Kazakhstan); systematics, biostratigraphy and biogeography. *Acta Geologica Polonica*, **75** (1), e37.

Ammonites and inoceramid bivalves are described from an interval spanning the upper Lower to upper Upper Albian at five localities in the Mangyshlak Anticlinorium in central-western Kazakhstan. The stratigraphic record is discontinuous. Ammonites include both endemic and more cosmopolitan taxa, with representatives of the genera *Beudanticeras*, *Cleoniceras*, *Hoplites*, *Anahoplites*, *Semenoviceras*, *Euhoplites*, *Dimorphoplites*, *Epihoplites*, *Callihoplites*, *Sulcohoplites*, *Arrhaphoceras*, *Placentoceras*, *Hysterocheras*, *Pervinqueria*, *Goodhallites*, *Idiohamites*, and *Hamites*. The inoceramid bivalves present include representatives of the genera *Actinoceramus* and *Gneisoceramus*.

**Key words:** Cretaceous; Albian; Ammonites; Inoceramid bivalves; Mangyshlak; Kazakhstan.

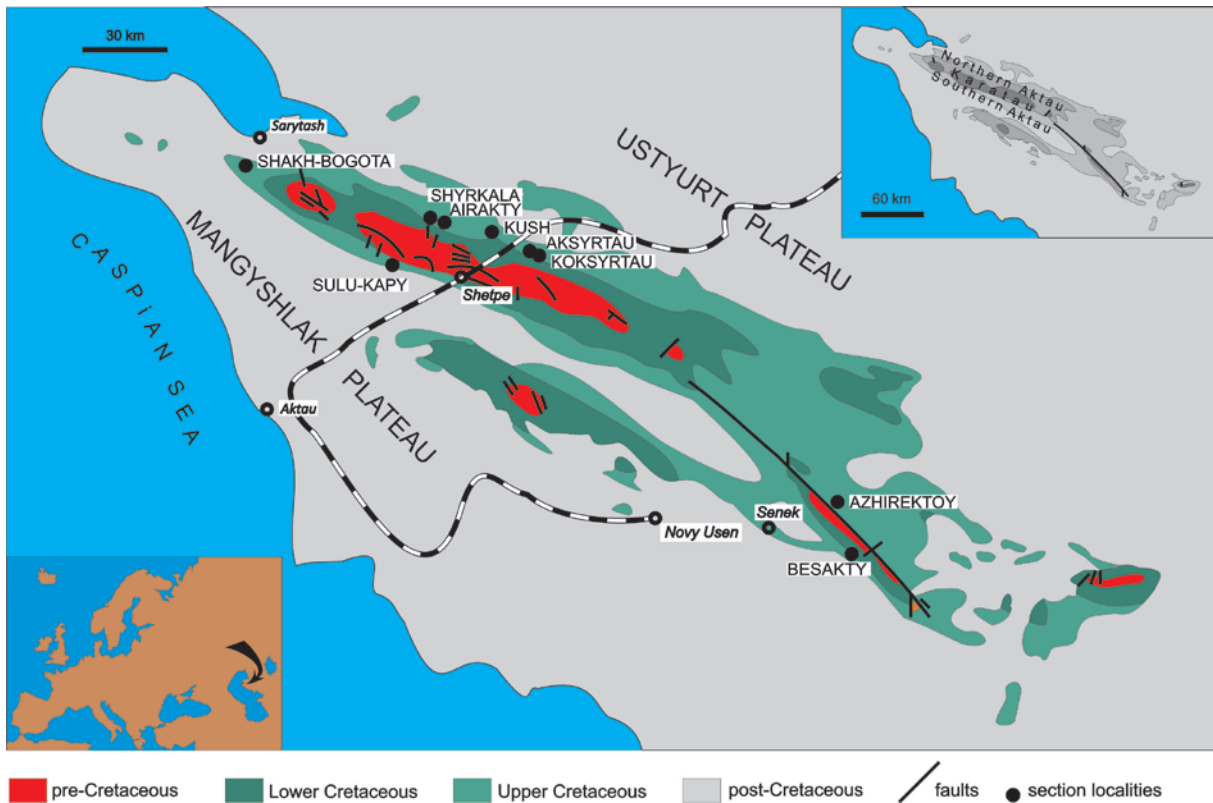
## INTRODUCTION

The Mangyshlak Anticlinorium, together with the Kopet Dagh, provide the most complete record of the Albian in western Central Asia (Luppov *et al.* 1986; Text-fig. 1). With its thick succession characterised by a variable and rich fossil record, famous for its ammonite and inoceramid faunas (Saveliev 1960, 1962, 1973, 1981), Mangyshlak becomes an important reference point for the biostratigraphy and biogeography of the Albian in the eastern margin of the North European Biogeographic Province. The Albian strata yielded rich ammonite and inoceramid faunas, allowing for the development of a refined biostratigraphic succession with high regional correlation potential (e.g., Saveliev 1960, 1962, 1973, 1981, 1992). For ammonites, only the Lower Albian material has been fully published (Saveliev 1973, 1992).

Although the ammonites of the Middle and Upper Albian have been discussed in numerous papers (e.g., Sokolov 1966, 1967; Saveliev 1960, 1981; Michailova and Saveliev 1989, 1994; Marcinowski *et al.* 1996), their systematics has never been published in more detail. The inoceramids were presented by Saveliev (1962). However, our understanding of this group has markedly changed since then.

The aim of the present paper is to examine the systematics, biostratigraphy, and biogeography of the ammonite and inoceramid faunas of the Middle and Upper Albian of the Mangyshlak Anticlinorium. This study is based on new, original material of both faunas collected recently from representative sections of the anticlinorium. Fieldwork on the studied sections was carried out during two Mangyshlak Field Expeditions of the University of Warsaw to the Mangyshlak Mountains. The 1992 expedition was led





Text-fig. 1. Geological sketch-map of the Mangyshlak Mountains.

by the late Prof. Ryszard Marcinowski and accompanied by Danuta Olszewska-Nejbert, Irek Walaszczyk, and Prof. Ludmila Kopaevich from Moscow State University. The 1999 expedition was conducted by R. Marcinowski and I. Walaszczyk.

#### LOCALITY DETAILS

The Mangyshlak Anticlinorium, located in central-western Kazakhstan (Text-fig. 1), consists of the Permian–Paleogene succession and represents a young Neogene structure of the Turanian epi-Variiscan Platform (Muromtzev 1973). It stretches roughly NW–SE, from the Mangyshlak Peninsula on the Caspian Sea to the Kazakhstan Plains in the east. The axial part of the anticlinorium, forming the highest parts (Karatau) of the Mangyshlak Mountains, is composed of Permian–Jurassic rocks. The Cretaceous forms the two wings of the anticlinorium, which constitute two parallel mountain ranges (Aktau), NE and SW of the Karatau. The entire Cretaceous succession is well exposed along the structure, extending almost 300 km parallel to its axis. The expanded siliciclastic

Albian succession of the structure is up to 1000 m thick (Saveliev 1973; Benenson *et al.* 1985). Both the Aptian/Albian and Albian/Cenomanian boundaries are discontinuous, usually with associated stratigraphic gaps (Naidin *et al.* 1984; Luppov *et al.* 1986, fig. 38; Marcinowski *et al.* 1996).

The study is based on five representative sections located along the axis of the anticlinorium. From NW to SE, these are sections at Shakh-Bogota, Sulu-Kapy, Shyrkala-Airakty, Koksyrtau-Aksyrtau/Kush, and Besakty (Text-figs 1, 2). The Albian strata of these sections, as described herein, extend the logs published by Marcinowski *et al.* (1996), which focused on the topmost Albian through the Santonian of the area. The palaeontological material studied is housed in the Stanisław Józef Thugutt Museum of the Faculty of Geology at the University of Warsaw.

#### Sections

**Shakh-Bogota:** This is the most north-westerly located section, close to the Caspian Sea. Most of the succession was documented in Marcinowski *et al.* (1996, fig. 3). Bed 1 is an approximately 8 m

thick unit of grey sandstone, with two horizons (right below its top and about 5 m below its top) containing ammonites and inoceramids. This bed extends down to a level of large sandstone concretions (up to 1 m in diameter) and below to Bed B, which consists of fine-grained sandstone. Further down is Bed C, made up of grey mudstone. Bed D, almost at the bottom of the studied part of the section, is composed of limonitized sandstone concretions with ammonite fragments.

**Sulu-Kapy:** This section is located in the Southern Aktau, SE of the Shakh-Bogota section. The succession starts with grey mudstone (Bed J), with limonitic crusts at its top. This bed is overlain, with a clear discontinuity, by a 15 cm thick phosphatic horizon (Bed I), containing numerous ammonites, inoceramids, non-inoceramid bivalves, gastropods, wood fragments, and shark teeth. This horizon is followed by a 12 m thick siltstone unit with two horizons of limonitic crusts. Higher up is a 14 m thick unit (Bed G) of green-grey quartz sands with glauconite and large sandstone concretions, up to 1 m in diameter, with rare ammonites. Bed F is composed of light-grey, non-calcareous mudstone with limonitic crusts and rare limonitized ammonites. The overlying unit (Bed E) is a 0.3 m unit of cross-bedded sandstone with rare ammonites. Bed D is an 8.5 m thick unit of light-grey sandy mudstone with limonitic crusts. The overlying unit (Bed C) is a 3.2 m bed of grey sandstone with large (up to 1 m in diameter) sandstone concretions, where ammonites and inoceramids occur commonly. The overlying unit (Bed B) is a 16 m thick unit of grey sandy mudstone with limonitic crusts and is non-fossiliferous. The overlying fine- and middle-grained sandstone contains large (up to 1.5 m in diameter) sandstone concretions. The smaller concretions yielded numerous ammonites and inoceramids. Bed A is capped by a 0.25 m thick phosphatic horizon (phosphatic conglomerate) with numerous ammonites. The topmost part of the Albian succession (Beds 2 and 3) are sandstone units; Bed 2 still contains small-sized phosphatic concretions, which disappear completely in Bed 1.

**Shyrkala-Airakty:** The section is located in the Northern Aktau, central part of the anticlinorium. The succession starts with a 0.3–0.4 m thick horizon of flat sandstone concretions (Bed P), limonitized, with rare ammonites. It is followed by an 11 m thick unit (Bed O) of grey, sandy mudstone, capped by a 0.3 m thick horizon (Bed N) with rare phosphatic concretions and numerous fossils. Bed M, 12 m thick, is composed of mudstone, less sandy, with numer-

ous limonitic crusts. Bed L is a 3.5 m thick unit of light-greenish sandstone, with large sandstone concretions at the bottom. At its top is a 0.3 m thick bed (Bed K) of sandstone concretions. The expanded unit (Bed J) is composed of light-yellow to grey, poorly cemented quartz sandstone with glauconite and rare limonitic crusts, forming a distinct horizon in the middle of the unit. It is overlain by a 1 m thick unit (Bed I) of large sandstone concretions, some flat ones up to 3 m in length. Beds H through A consist of alternating sandstone units and horizons of large concretions (up to 2 m in diameter in Beds E and C). Bed [-1] consists of non-calcareous, non-fossiliferous mudstone with limonitic crusts. Bed 6 is composed of smaller, flat concretions (maximum 0.5 m in diameter) with limonitic crusts. The higher part of the Albian succession is described in detail in Marcinowski *et al.* (1996, pp. 12–14). Beds 1 through 13 are poorly cemented sandstones with large sandstone concretions (up to 2.5 m in diameter in Bed 1A). Only Beds 6 and 8 are relatively thin interlayers of silty clays. Beds 10, 12, and 14 are 30 to 40 cm thick phosphatic horizons composed of phosphatic nodules. The Albian ends with the 8 m thick Bed 15, composed of grey, non-carbonate mudstone with muscovite flakes.

**Koksyrtau-Aksyrtau and Kush:** This section is located about 25 km southeast of the Shyrkala-Airakty section. The succession starts with Bed [-E], a 20 m thick unit of poorly cemented sandstone. These are followed by Beds [-D] through [-A], an interval approximately 40 m thick. With the exception of Bed [-A], all are composed of grey, poorly cemented sandstone; Bed [-D] contains large sandstone concretions, up to 2 m in diameter; Bed [-C] is unfossiliferous; Bed [-A] is composed of grey mudstone. The overlying units, up to Bed 5, are composed of grey, poorly cemented sandstone with glauconite. Beds E, 1, and 4 are phosphatic horizons with phosphatic nodules. Bed 6 is a characteristic 5 m thick unit of sandy clays. The Albian part of the section ends with a 7.5 m thick Bed 7, composed of poorly cemented sandstone with glauconite and limonitic crusts.

**Besakty:** The section lies within the southern limb of the Tumgachi Anticline, 10 km southeast of the Besakty well. No new observations or collections were made during the 1999 expedition, and consequently, the entire succession treated herein was described in Marcinowski *et al.* (1996, pp. 29–33). The Albian of the Besakty section is almost twice as thick as the Albian in sections further to the northwest and represents only the upper part of the Upper Albian.



## FAUNAL SUCCESSION

## The ammonites

The sequence of ammonite assemblages in the sections studied is discontinuous and, at some levels, dominated by endemic taxa. The faunas are discussed in terms of the zonal schemes set out in Text-fig. 3.

There is a very limited Lower Albian record in the Shyrkala-Airakty section, consisting of *Beudanticeras* sp. from 12 m below the *Hoplites* fauna of Bed O and *Cleonicer* cf. *bicostatum* (Mirzoyev, 1970) from 11 m below the *Hoplites* fauna. *Cleonicer* of *bicostatum* type (although not that species) characterise the *Cleonicer* *floridum* Zone of the upper Lower Albian *Douvilleicer* *mammillatum* Zone of authors (Amédro, personal communication 2020).

*Hoplites* (*Hoplites*) *benettianus* (J. de C. Sowerby, 1826) is present in Beds K and O of the Shyrkala-Airakty section. The careful records in Amédro *et al.* (2014) show this species to define a total range zone that extends from the uppermost Lower Albian into the lowest Middle Albian. The co-occurrence of *benettianus* with *Anahoplites planus* (Mantell, 1822) in Bed O show this level to be within the lower Middle Albian, as the latter species first appears in the *Anahoplites intermedius* Zone. The age of the *benettianus* fauna is confirmed by the occurrence of *Actinoceramus concentricus expandoclunus* Crampton, 1996 in the matrix of specimens of *benettianus*

(MWGUW ZI/63/0338, 0339) in Bed O; this bivalve has a very short range in the lower Middle Albian.

The next fauna is that of the *Anahoplites rossicus* Zone of authors. The index species occurs in Beds A, E, G, and J of the Shyrkala-Airakty section, Beds C, E, F, and G of the Sulu-Kapy section, and Bed [-D] of the Koksyrtau-Aksyrtau section. The *rossicus* fauna is lower Upper Albian on the basis of the occurrence of *Actinoceramus sulcatus* (Parkinson, 1819) in Bed E of the Shyrkala-Airakty section (MWGUW ZI/63/1295). This species is restricted to the lower Upper Albian *cristatum*, *pricei*, and lower *inflatum* zones

Bed J of the Sulu-Kapy section yielded *Anahoplites planus*, *Dimorphoplites beresovkaensis* Glazunova, 1968, and *Sulcohoplites altifurcatus* Michailova and Saveliev, 1994. The last-named species was regarded as Middle Albian, *rossicus* Zone by Michailova and Saveliev (1994).

The *Semenovicer* *michalskii* Zone is represented by near-monospecific assemblages of the index species. It is recorded from Beds 1/1, 1, 1/2, and 2 of the Shakh-Bogota section, Beds 1A and 1B of the Shyrkala-Airakty section, and Beds A and B of the Koksyrtau-Aksyrtau section. The presence of *Euhoplites* cf. *trapezoidalis* Spath, 1930 in Bed 1A of the Shyrkala-Airakty section dates the *michalskii* fauna there to the Upper Albian *cristatum* Zone.

Bed A of the Sulu-Kapy section has yielded *Hysterocher* *binum* (J. Sowerby, 1815), *H. orbigny* (Spath, 1922), *Pervinquieria* (*Deiradoceras*) sp.,

Sub-stage	Ammonite zone		Ammonite and inoceramid ranges	Inoceramid zones
	Western Europe	Western Kazakhstan		
L. Cen. (part)				
Upper Albian	<i>Pleurohoplites briacensis</i>			
	<i>Pervinquieria perinflata</i>	<i>Lepthoplites cantabrigensis</i>		
	<i>Pervinquieria rostrata</i>			
	<i>Pervinquieria fallax</i>			
	<i>Pervinquieria inflata</i>	<i>Pervinquieria inflata</i>		
	<i>Pervinquieria pricei</i>			
Middle Albian	<i>Diploceras cristatum</i>	<i>Semenovites michalskii</i>		
	<i>Anahoplites daviesi</i>	<i>Anahoplites rossicus</i>		
	<i>Dimorphoplites biplicatus</i>	<i>Hoplites perarmatus</i>		
	<i>Dimorphoplites niobe</i>			
	<i>Anahoplites intermedius</i>	<i>Anahoplites intermedius</i>		
	<i>Hoplites dentatus</i>			
L. Albian (part)	<i>Lyelliceras lyelli</i>			
	<i>Lyelliceras pseudolyelli</i>	<i>Hoplites benettianus</i>		
	<i>Hoplites steinmanni</i>			
	<i>Ottohoplites hilli</i>			
	<i>Hemisonneratia puzosiana</i>			
	<i>Cleonicer</i> <i>floridum</i>			
	<i>Sonneratia kitchini</i>			

Text-fig. 3. Upper Lower, Middle, and Upper Albian ammonite and inoceramid zones and ranges of recognised taxa for Western Europe and for Western Kazakhstan; ammonite zonation for Western Kazakhstan is a modified scheme after Bogdanova *et al.* (1989); inoceramid zonation after Crampton (1996), Crampton and Gale (2009), and Gale *et al.* (2025).



*Pervinquieria (P.) pricei* (Spath, 1922), *Goodhallites goodhalli* (J. Sowerby, 1820), and *Idiohamites* sp., indicating the Upper Albian *pricei* Zone.

The appearance of *Arrhaphoceras substuderi* Spath, 1928, and *Callihoplites vraconensis vraconensis*, in Bed 9 and Beds 8/9 of the Besakty section, where they are associated with abundant *Placenticerias kolbajense* (Sokolov, 1967) indicates the *perinflata* Zone. Elements of this zone are also present in fossil horizon 2 of the Kolbay section of Kennedy *et al.* (2008): *Arrhaphoceras subtetragonum* Spath, 1928, *Callihoplites dorsetensis* Spath, 1928, *Lepthoplites gracilis* Spath, 1928, *Placenticerias kolbajense* (Sokolov, 1967), *Idiohamites dorsetensis* Spath, 1939, and *Lechites moreti* Breistroffer, 1936. This is a *perinflata* Zone fauna, which the authors correlated with Bed 17 of the Azhirektoy section and Bed 1 of the Besakty section. The association of *Arrhaphoceras* cf. *precoupei* Spath, 1928, and *Placenticerias* sp. in Bed 14 of the Besakty section also belongs to the *perinflata* Zone.

### The inoceramids

The oldest record comes from Bed O of the Shyrkala-Airakty section. The material is represented by *Actinoceras salomoni* (d'Orbigny, 1850), *Actinoceras concentricus expandochlunis* Crampton, 1996, and *Actinoceras concentricus concentricus* (Parkinson, 1819). The details of the vertical distribution of particular inoceramid species are unknown. It may be assumed that this 11 m thick bed spans the interval starting in the topmost Lower Albian and ranges through the *Anahoplites intermedius* Zone of the lower Middle Albian. Similarly, *A. c. concentricus* and *A. c. expandochlunis* occur in Bed J of the Sulu-Kapy section, indicating the lower Middle Albian age of this unit.

The next assemblage represented in the studied succession is that of *Actinoceras sulcatus*. The assemblage is richly represented in the upper part part of the *Anahoplites rossicus* ammonite Zone and in the succeeding ammonite zone of *Semenoviceras michalskii*. The youngest inoceramid assemblage comes from Bed SuA of the Sulu-Kapy section, represented by *Actinoceras sulcatus biometricus* Crampton, 1996. This assemblage co-occurs with ammonites of the *Pervinquieria inflata* Zone.

*Gnesioceras anglicus* (Woods, 1911) occurs throughout the whole interval studied. The species is best represented in the upper part of the *Anahoplites rossicus* and in the *Semenoviceras michalskii* zones of the lower Upper Albian. Our collection does not

reveal any reliable evolutionary trends; more material is needed.

Bed SuA (Sulu-Kapy section) of the *Pervinquieria pricei* Zone yielded a single specimen referred to '*Inoceramus*' *liwerovskya*e Saveliev, 1962, a poorly known species, regarded by Saveliev (1962) as a descendant of *Gnesioceras anglicus*.

### BIOSTRATIGRAPHY

The mixed biogeographical character of the Albian ammonite faunas of Mangyshlak precludes direct application of the West European ammonite zonation to the Albian succession of the region. The scheme used herein (Text-fig. 3) is a slightly modified zonation proposed and widely discussed by Michailova and Saveliev (1989). Ammonite taxa, known from the entire North European Biogeographic Province, scattered through the succession, allow for correlation of both schemes. Additionally, very supportive in correlation of the Mangyshlak ammonite zonation with the West European standard are inoceramids, particularly those of the *Actinoceras* lineage (Text-fig. 3). The lineage, studied in detail by Crampton (1996; and subsequent papers: Crampton in Kennedy *et al.* 1999; Crampton and Gale 2005, 2009), revealed a high correlation potential of the genus for the entire Euramerican Biogeographic Region.

The lowest zone suggested by the ammonite record at hand, from Bed R of the Shyrkala-Airakty section, is the upper Lower Albian *Cleoniceras floridum* Zone subdivided in the Mangyshlak succession into two separate zones of *Sonneratia vniigri* and *Otohoplites sinzowi*.

The Middle Albian starts with the correlatives of the *Hoplites dentatus* Zone. This zone has long been recognised in Mangyshlak and referred to as the zone of 'black ammonites' (Michailova and Saveliev 1989), the name referring to the dark-brown colour of the material. The zone is widely distributed all over the North European Biogeographic Province. The zonal taxa are missing from the studied material, however, the presence of *Actinoceras salomoni*, *A. concentricus expandochlunis*, and *A. concentricus concentricus*, all from Bed O of the Shyrkala-Airakty section, suggests an interval spanning the topmost Lower Albian, the basal Middle Albian *Hoplites dentatus* Zone, and up to the *Anahoplites intermedius* Zone. The presence of the latter zone is also confirmed by the ammonites, *Anahoplites planus* and *Hoplites benettianus*, known to co-occur in the *A. intermedius* Zone. It is further suggested by the ammonite

*Dimorphoplites beresovkaensis*, known from Bed J of the Sulu-Kapy section, recorded from the *A. intermedius* Zone of the Russian Platform (Michailova and Saveliev 1989).

The succeeding *Hoplites perarmatus* Zone, recognised in the Mangyshlak Mountains by Saveliev (1976), is geographically limited to western Central Asia (Mangyshlak, Ustiurt, northern Peri-Caspian Region). The presence of *Dimorphoplites niobe* and of *Anahoplites* aff. *daviesi* in this zone suggests its correlation with most of the *Euhoplites loricatus* and of the lower *Euhoplites latus* zones (Michailova and Saveliev 1989). This zone is very poorly documented in our material.

The succeeding *Anahoplites rossicus* Zone was distinguished originally based on the Mangyshlak succession (established by Luppov in unpublished material from 1947; see discussion in Michailova and Saveliev 1989). Besides Mangyshlak, the zone is reported from the Northern Peri-Caspian, Ustyurt, Kopet Dagh, and Hissar Range of western Uzbekistan (Michailova and Saveliev 1989). The zone is represented mostly by endemic ammonite species. The chronostratigraphic position of this zone has been a matter of debate since its first description in 1947; it was either claimed to be late Middle or early Late Albian in age (e.g., Saveliev 1962, 1981; Bogdanova *et al.* 1963; and discussion in Michailova and Saveliev 1989). The key argument was the presence / absence of representatives of *Actinoceras sulcatus* in the zone, the species which first appears in the *Dipoloceras cristatum* Zone, marking the base of the Upper Albian in the West European standard sections. Bogdanova *et al.* (1963) also reported a specimen of *D. cristatum* from the *A. rossicus* Zone of Kopet Dagh, which was to confirm the interpretation; the source location of the specimen was questioned however (Michailova and Saveliev 1989). Based on the Mangyshlak material, studied herein, it seems that the controversy was caused by the fact that *Actinoceras sulcatus* appears in the middle of the *A. rossicus* Zone, and consequently, both claims could have been right.

The two overlying *Semenovites litschkovi* and *Semenovites michalskii* zones, in the scheme of Michailova and Saveliev (1989), are combined herein into a single *S. michalskii* Zone, based on the synonymy of both index taxa (see the systematic chapter below). The *S. michalskii* Zone, as interpreted herein, corresponds to the *D. cristatum* and *H. orbigny* zones, as suggested earlier by Michailova and Saveliev (1989).

The *Pervinquieria inflata* Zone corresponds to an interval between the *Pervinquieria pricei* and *Per-*

*vinquieria perinflata* zones of the West European zonation.

The *Leptohoplites cantabrigensis* Zone, the top-most zone of the Upper Albian, correlates with the *Pervinquieria perinflata* and the lower part of the *Pleurohoplites briacensis* zones of the West European standard subdivision. The presence of the *perinflata* zone is indicated by the appearance of *Arrhaphoceras substuderi* Spath, 1928, and *Callihoplites vraconensis vraconensis*, in Bed 9 and Beds 8/9 of the Besakty section.

#### SYSTEMATIC PALAEOLOGY: AMMONITES (W.J. Kennedy)

#### Conventions

Repositories of specimens are indicated as follows:

BGS: British Geological Survey, Keyworth, Nottinghamshire.

BMNH: The Natural History Museum, London.

MWG UW: The Stanisław Józef Thugutt Museum of the Faculty of Geology of the University of Warsaw (collection acronym MWGUW ZI/63).

The suture terminology is that of Korn *et al.* (2003): E = external lobe; A = adventive lobe; U = umbilical lobe; I = internal lobe.

All dimensions are given in millimetres.

The taxonomy of Wright (1996) is followed here. Many of the species described below have received detailed discussion in recent publications, and these are referred to rather than repeating them.

Order Ammonoidea Zittel, 1884

Superfamily Desmoceratoidea Zittel, 1895

Family Desmoceratidae Zittel, 1895

Subfamily Beudanticeratinae Breistroffer, 1953

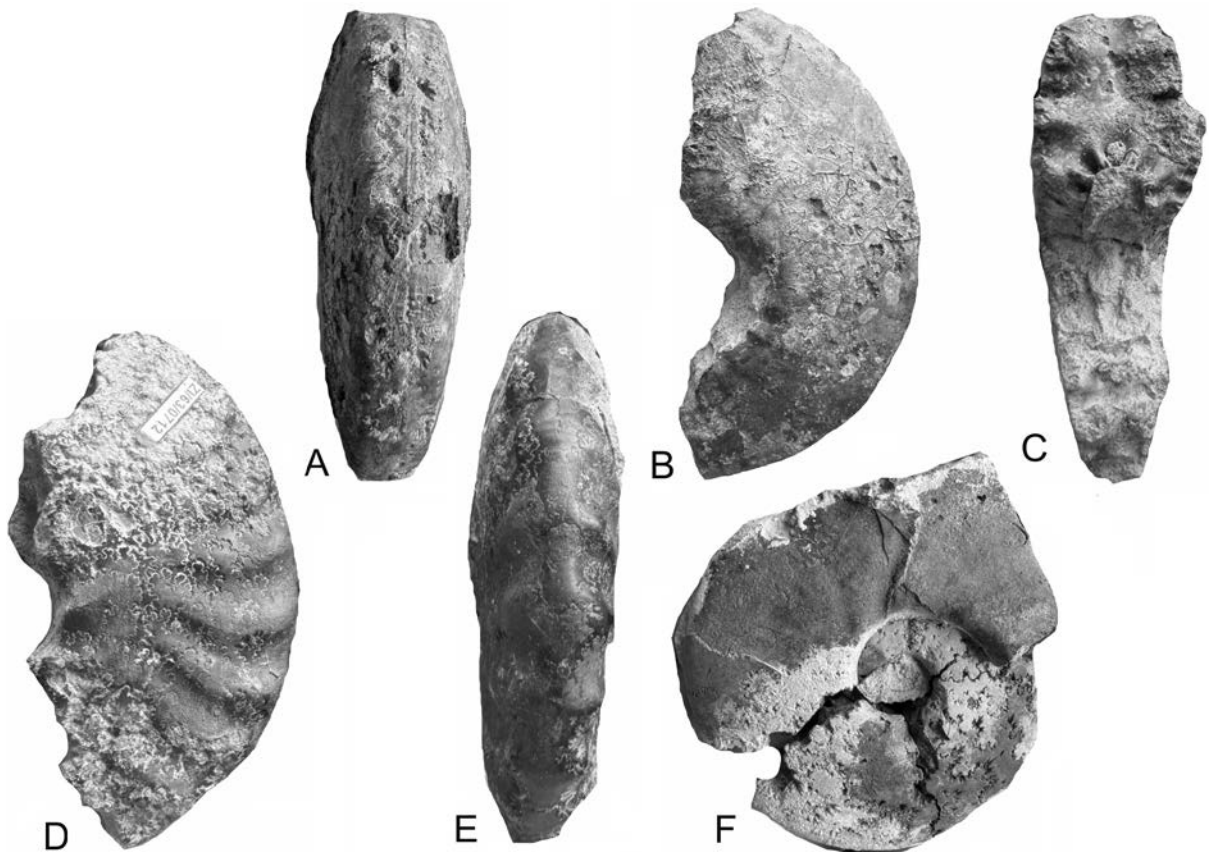
Genus *Beudanticeras* Hitzel, 1902

TYPE SPECIES: *Ammonites beudanti* Brongniart, 1822 (pp. 95, 99, 394, pl. 7, fig. 2), by original designation (Hitzel 1902, p. 875).

*Beudanticeras* sp.

(Text-fig. 4F)

MATERIAL: MWGUW ZI/63/0713, from 12 m below the *Hoplites* Zone, Shyrkala-Airakty.



Text-fig. 4. A–C – *Anahoplites planus* (Mantell, 1822), MWGUW ZI/63/0354, from Bed O of the Shyrkala-Airakty section. D, E – *Cleoniceras* cf. *bicostatum* (Mirzoyev, 1970), MWGUW ZI/63/0712, from 11 m below the *Hoplites* Zone, Shyrkala-Airakty section. F – *Beudanticeras* sp., MWGUW ZI/63/0713, from 12 m below the *Hoplites* Zone, Shyrkala-Airakty section.

**DESCRIPTION:** The specimen is an internal mould of a phragmocone 46.5 mm in diameter, and a fragmentary 180° sector of body chamber. Coiling is involute, the small, shallow umbilicus comprising 36% of the diameter, the umbilical wall very feebly convex, the umbilical shoulder broadly rounded. The whorl section is compressed, the whorl breadth to height ratio 0.36, the greatest breadth just outside the umbilical shoulder, the flanks very feebly convex, converging to broadly rounded ventrolateral shoulders and a feebly convex venter. The phragmocone is smooth. Parts of three, perhaps four progressively strengthening constrictions are present on the body chamber fragment. They are best-developed on the inner flank, where they are straight and prorsiradiate, and flanked by a well-developed adapertural collar rib.

**DISCUSSION:** If the generic identity of the specimen is clear, specific identity is not, and it is left in open nomenclature.

**OCCURRENCE:** As for material.

Family Cleoniceratidae Whitehouse, 1926  
Genus *Cleoniceras* Parona and Bonarelli, 1897

**TYPE SPECIES:** *Ammonites Cleon* d'Orbigny, 1850, p. 124, by original designation (Parona and Bonarelli 1897, p. 83).

*Cleoniceras* cf. *bicostatum* (Mirzoyev, 1970)  
(Text-fig. 4D, E)

compare:

- 1970. *Anacleoniceras bicostatum* Mirzoyev, p. 113, text-figs a-d.
- 1992. *Anacleoniceras bicostatum* Mirzoyev; Saveliev, pl. 7, fig. 2; pl. 8, fig. 2.
- 2002. "*Anacleoniceras bicostatum* Mirzoyev"; Riccardi and Medina, p. 336.



2011. *Cleonicerias bicostatum* (Mirzoyev, 1970); Klein and Vašicek, pp. 199, 201.

TYPE: The holotype is the original of Mirzoyev (1970, text-figs a–d), from the Lower Albian of the Gissar Range of eastern Turkmenistan.

MATERIAL: MWGUW ZI/63/0712, from 11 m below the *Hoplites* Zone in the Shyrkala-Airakty section.

DESCRIPTION: The specimen is an internal mould of a 180° whorl sector of phragmocone 72 mm in diameter. Coiling is involute, the umbilicus small, shallow, with a low, feebly convex wall and broadly rounded umbilical shoulder. The whorl section is compressed, with an intercostal whorl breadth to height ratio of 0.55. The greatest breadth is below mid-flank, the flanks very feebly convex, the outer flanks converging to broadly rounded ventrolateral shoulders and a rounded/feebly fastigiate venter. There are three strong, markedly prorsiradiate umbilical bullae preserved on the fragment. They give rise to pairs of low, broad, falcoid ribs that are strongly rursiradiate on the inner flank before flexing forwards, concave on the outer flank, and strengthening into blunt bullae that form an obtuse broad chevron on the venter. The sutures are very corroded.

DISCUSSION: This specimen belongs to the group of small, coarsely ornamented *Cleonicerias* assigned to *Anacleoniceras* Mirzoyev, 1969 (type species by original designation *Anacleoniceras caseyi* Mirzoyev, 1969, p. 39, pl. 4, figs 1, 2; text-fig. 1) by some authors. Wright (1996, p. 96) treated *Anacleoniceras* as a subgenus of *Cleonicerias*, suggesting species assigned to it as “Probably microconchs of *C. (Cleonicerias)*.” With a single fragment only, there is little to be said, but Francis Amédro (personal communication) has pointed out to me that small *Cleonicerias* of this type, including those assigned to *Cleonella* Destombes, 1979 (a *nomen nudum*), characterise the upper Lower Albian, but are currently split into a series of narrowly conceived species.

OCCURRENCE: Upper Lower Albian of Turkmenistan and, possibly, the Mangyshlak Mountains of Western Kazakhstan.

Superfamily Hoplitoidea H. Douvillé, 1890

DISCUSSION: The very different approaches to suprageneric classification within the superfamily is

reviewed in detail by Francis Amédro and his collaborators (Amédro and Matrimon in Amédro *et al.* 2014, p. 195 et seq.), and their conclusions are adopted here. These authors also review the concept of the species within the group, pointing out that studies of large collections from single horizons in expanded sequences revealed wide variation, interpreted as intraspecific. Examples from the Hoplitoidea include *Neogastrolites* McLearn, 1931 of the United States Western Interior (Reeside and Cobban 1960; Kennedy and Cobban 1976; Reymont and Kennedy 1998), *Callihoplites* Spath, 1925a (Kennedy *et al.* 2008), *Otohoplites* Steinmann, 1925, and *Hoplites* Neumayr, 1875 (Amédro *et al.* 2014), and *Schloenbachia* Neumayr, 1875 (Juignet and Kennedy 1976; Kennedy and Juignet 1984; Wright and Kennedy 2015) from Western Europe. The same variation is seen in the three species from the Mangyshlak Mountains that are represented by significant numbers of specimens: *Hoplites (Hoplites) benettianus* (J. de C. Sowerby, 1826), *Anahoplites rossicus* (Sinow, 1910), and *Semenoviceras michalskii* (Semenov, 1899). To translate and paraphrase the observation of Eudes-Deslongchamps (1849) on Jurassic pleurotomarid gastropods quoted by Amédro *et al.* (2014, p. 198): ‘the more specimens, the fewer species’.....as for snails, so for ammonites.

Family Hoplitidae H. Douvillé, 1890  
Subfamily Hoplitinae H. Douvillé, 1890  
Genus and Subgenus *Hoplites* Neumayr, 1875

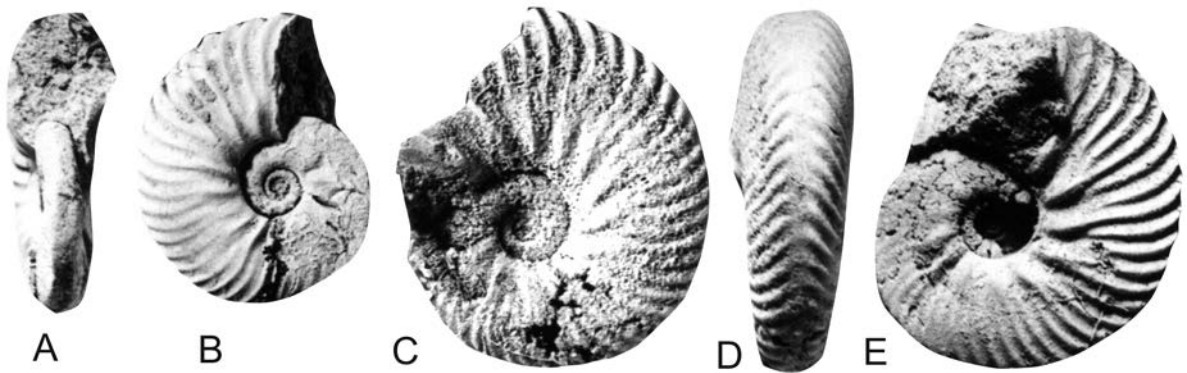
TYPE SPECIES: *Ammonites dentatus* J. Sowerby, 1821 (p. 3, pl. 308, fig. 3 only) (ICZN Specific name no. 489).

*Hoplites (Hoplites) benettianus* (J. de C. Sowerby, 1826)  
(Pl. 1, Figs 1–14; Pl. 2, Figs 1–12; Text-fig. 5A–E)

1826. *Ammonites benettianus* J. de C. Sowerby, p. 77, pl. 539.

2014. *Hoplites (Hoplites) benettianus* (J. de C. Sowerby, 1826); Amédro and Matrimon in Amédro *et al.*, p. 207, pl. 18, fig. 1; pl. 19, figs 1–15; pl. 20, figs 1–5; pl. 21, figs 1–4; pl. 22, figs 1, 2 (with full synonymy).

TYPE: The neotype, designated by Cooper and Owen (2011a, p. 340, explanation of text-fig. 2) is BMNH 24746, from the lower Middle Albian Gault Clay of Crockerton, Wiltshire, in southern England. It was figured by Cooper and Owen (2011a, text-figs 2I, 3C).



Text-fig. 5. *Hoplites (Hoplites) benettianus* (J. de C.Sowerby, 1826). A, B – MWGUW ZI/63/0169; C, D – MWGUW ZI/63/0178; E – MWGUW ZI/63/0162. All from the *Hoplites* Zone, Shyrkala-Airakty. All figures are  $\times 2$ .

**MATERIAL:** MWGUW ZI/63/0157, 0162, 0169, 0177, 0178, 0332–0340, 0342–0351, 0353, 0355–0361 are from Bed O; MWGUW ZI/63/0709 and 0711 are from Bed K; all specimens are from the Shyrkala-Airakty section.

**DESCRIPTION:** The 33 specimens assigned to *H. (H.) benettianus* are interpreted as a single variable species, characterised by umbilical bullae that give rise to pairs of ribs, the ventral terminations of the ribs alternating in position on either side of the narrow siphonal zone. They are described below in terms of robust and gracile end member variants, linked by passage forms.

**Robust forms.** There are six individuals at the robust end of the spectrum of variation: MWGUW ZI/63/0157, 0177, 0332, 0335, 0337, and 0339. MWGUW ZI/63/0157 (Pl. 1, Figs 10, 11) is a nucleus 21 mm approximately in diameter, with six massive umbilical bullae per half whorl that give rise to pairs of coarse ribs that are concave on the outer flanks and ventrolateral shoulders, their terminations alternating on either side of a barely developed median depression. MWGUW ZI/63/0177 (Pl. 1, Figs 1, 2) is a 180° sector of body chamber with a maximum preserved diameter of 40 mm. Coiling is moderately involute, the deep umbilicus comprising 34% of the diameter. The umbilical wall is convex, outward-inclined, the umbilical shoulder broadly rounded. The intercostal whorl section is compressed reniform, the greatest breadth at the umbilical shoulder. The costal whorl breadth to height ratio is 1.6, the whorl section hexagonal with the greatest breadth at the massive umbilical bullae. Six low, broad ribs arise at the umbilical seam, and strengthen across the umbilical wall, developing into massive umbilical bullae. These

give rise to pairs of coarse, straight, prorsiradiate ribs, and there is a single long intercalated rib. All ribs strengthen into prorsiradiate bullae on the ventrolateral shoulder, then efface. The ribs alternate in position across the line of the mid-venter. MWGUW ZI/63/0332 (Pl. 1, Figs 13, 14) is a 180° whorl sector, the adapertural 90° body chamber, the estimated maximum preserved diameter 103 mm. The intercostal whorl breadth to height ratio is 1.2, the costal ratio 1.36. There are seven strong umbilical bullae on the fragment, and fifteen ribs at the ventrolateral shoulder, the ribs arising in pairs from the bullae and intercalating. They are straight on the inner flank, flexing forwards and feebly concave on the outer flank, and strengthening into well-developed prorsiradiate ventrolateral bullae, from which an effacing rib sweeps forwards to form an asymmetric chevron with the adaperturally displaced rib on the opposite flank. MWGUW ZI/63/0335 is a phragmocone 94 mm in diameter, a slightly more densely ribbed individual, with eight umbilical bullae per half whorl, and seventeen ribs at the ventrolateral shoulder.

**Gracile forms.** There are nineteen individuals from the gracile end of the spectrum of variation: MWGUW ZI/63/0162, 0169, 0178, 0334, 0336a–c, 0344, 0346–0351, 0355, 0356, 0358, 0359, and 0711.

Costal dimensions are as follows:

	D	Wb	Wh	Wb;Wh	U
MWGUW ZI/63/0350	45.5 (100)	– (–)	19.8	– (–)	14.5 (31.9)
MWGUW ZI/63/0334	50.9 (100)	15.4 (30.3)	24.0 (47.2)	0.64	13.7 (26.9)
MWGUW ZI/63/0349	74.6 (100)	24.0 (32.2)	30.0 (40.2)	0.8	24.4 (32.7)
MWGUW ZI/63/0344	80.4 (100)	27.8 (34.6)	32.9 (40.9)	0.84	24.6 (30.60)



Text-fig. 6. The holotype of *Hoplites studeri* Pict. et Camp. var *globosa* Semenov, 1899, copy of his pl. 4, fig. 2, from Tubé Koudouk.

The earliest growth stages seen are nuclei (MWGUW ZI/63/0162, 0169, 0178; Text-fig. 5A–E) that range from 22.1 to 26.9 mm in diameter; all retain a 180° to 240° sector of body chamber. Coiling is moderately involute, the umbilicus comprising around 36% of the diameter, shallow, with a low, outward-inclined, feebly convex umbilical wall and broadly rounded umbilical shoulder. The whorl breadth to height ratio is 0.76 in MWGUW ZI/63/0178 (Text-fig. 5C, D), the flanks feebly convex, subparallel, the ventrolateral shoulders broadly rounded, the venter very feebly convex. In these specimens, six to seven ribs per half whorl arise at the umbilical seam, and strengthen across the umbilical wall into long, narrow, prorsiradiate umbilical bullae. These give rise to pairs of ribs, and additional single ribs intercalate low on the flanks to give a total of around 20 at the ventrolateral shoulder in MWGUW ZI/63/0169 (Text-fig. 5A, B). The ribs are straight on the inner flanks, very feebly convex at mid-flank, strengthen, sweep forward, and are very feebly concave on the outer flanks, linking to feeble elongate oblique ventrolateral bullae that alternate in position on either side of the venter. The suture lines are not approximated, and the specimens are juveniles.

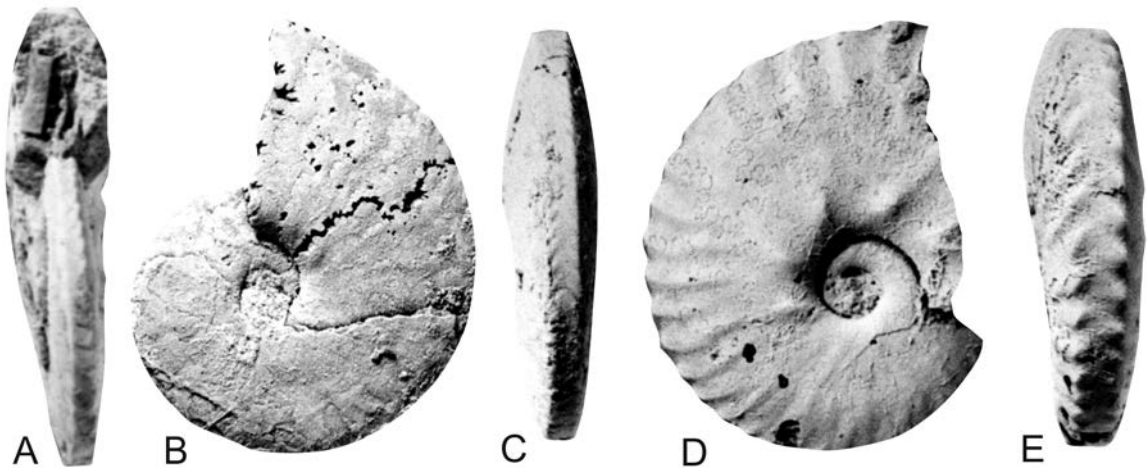
Most of the larger specimens are body chambers, extending to a 240° whorl sector, the largest (MWGUW ZI/63/0346), 106 mm in diameter. Coiling is moderately evolute, the umbilicus comprising around 30% of the diameter, shallow, with a convex, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is compressed,

the intercostal section with very feebly convex flanks, the outer flanks converging to broadly rounded ventrolateral shoulders, the narrow venter flattened. Costal whorl breadth to height ratios are as little as 0.64, the greatest breadth below mid-flank. Nine to eleven ribs arise at the umbilical seam and strengthen across the umbilical wall, developing into small, pinched umbilical bullae. These give rise to pairs of ribs, with a third rib feebly attached in some specimens, whilst additional single ribs may intercalate, arising low on the flanks. The ribs are feebly prorsiradiate, straight on the inner and mid-flank, then flexing forwards and feebly convex on the outermost flank and ventrolateral shoulder, where they strengthen into well-developed prorsiradiate bullae, which alternate in position and are linked by a chevron formed by the weak to effacing rib terminations. In MWGUW ZI/63/0334 (Pl. 2, Figs 1, 2) there are 10 umbilical bullae and 30 ribs at the ventrolateral shoulder of the 240° body chamber whorl sector, 11 and 24 in the 180° body chamber whorl sector of MWGUW ZI/63/0349 (Pl. 2, Figs 11, 12); 12 and 24 in the 180° sector of MWGUW ZI/63/0344 (Pl. 2, Figs 6, 7).

**Passage forms.** Twelve individuals have morphologies that connect robust and gracile end members, varying in whorl proportions, rib and tubercle strength and density: MWGUW ZI/63/0157, 0333, 0338, 0340–0343, 0345–0347, 0353, 0361, and 0709.

MWGUW ZI/63/0333 (Pl. 2, Fig. 8) is a 240° body chamber whorl sector 104 mm in diameter, with ribbing and tuberculation that is coarser than that of the most gracile variants, and a costal whorl breadth





Text-fig. 7. A–C – *Anahoplites planus* (Mantell, 1822), MWGUW ZI/63/1308, from Bed E of the Shyrkala-Airakty section. D, E – *Dimorphoplites* sp. juv., cf. *niobe* Spath, 1926a, MWGUW ZI/63/0134, from Bed G of the Shyrkala-Airakty section. All figures are  $\times 2$ .

to height ratio of over 0.8. This specimen shows eccentric coiling and weakening of the umbilical bullae on the last few ribs, and appears to be an adult and possibly a macroconch, the ribs arising in pairs from the bullae. MWGUW ZI/63/0361 (Pl. 1, Figs 6, 12) is a  $240^\circ$  whorl sector of body chamber with a maximum diameter of 75 mm and a costal whorl breadth to height ratio of 0.88, the ribbing and tuberculation coarser still on the adapical part of the body chamber, but weakening markedly before the aperture, suggesting that it too is an adult, and a possible microconch. MWGUW ZI/63/0353 (Pl. 1, Figs 3, 4), MWGUW ZI/63/0343 (Pl. 1, Figs 7, 8) and MWGUW ZI/63/0345 (Pl. 1, Fig. 9) with coarser ribs and tubercles complete the transition to the robust group of individuals.

None of the specimens have well-preserved sutures.

**DISCUSSION:** *Hoplites* (*H.*) *benettianus* is comprehensively described and illustrated by Amédro and Matrimon in Amédro *et al.* (2014, p. 207, pl. 18, fig. 1; pl. 19, figs 1–15; pl. 20, figs 1–5; pl. 21, figs 1–4; pl. 22, figs 1, 2) on the basis of over 200 specimens from Montreuil-sur-Barse in Aube, France, and the present material shows a comparable range of intraspecific variation. These authors set out criteria for separating *benettianus* from other *Hoplites* (*Hoplites*) in their text-fig. 19.

In the context of the Mangyshlak faunas, it is possible that *Hoplites studeri* Pict. et Camp. var. *globosa* of Semenov (1899, p. 116, pl. 4, fig. 2), is a further synonym of *benettianus*, although Spath (1926a, p. 183), thought it to be an *Arrhaphoceras*. Semenov's (1899)

original illustrations are reproduced here as Text-fig. 6. The original specimen is from Tubé Koudouk, a locality inferred to be close to the Shyrkala-Airakty area that yielded the present specimens.

**OCCURRENCE:** *Hoplites* (*H.*) *benettianus* ranges from the upper Lower Albian into the lowest Middle Albian. The material from Bed O of the Shyrkala-Airakty section most probably spans this interval, as suggested by associated inoceramids: *Actinoceras salomoni* and *A. concentricus expandoclunis*. The presence of the lower Middle Albian is also confirmed by the presence of *Anahoplites planus* (Text-fig. 4A–C).

#### Genus *Anahoplites* Hyatt, 1900

**TYPE SPECIES:** *Ammonites splendens* J. Sowerby, 1815 (pl. 103, fig. 2), by the original designation of Hyatt (1900, p. 584).

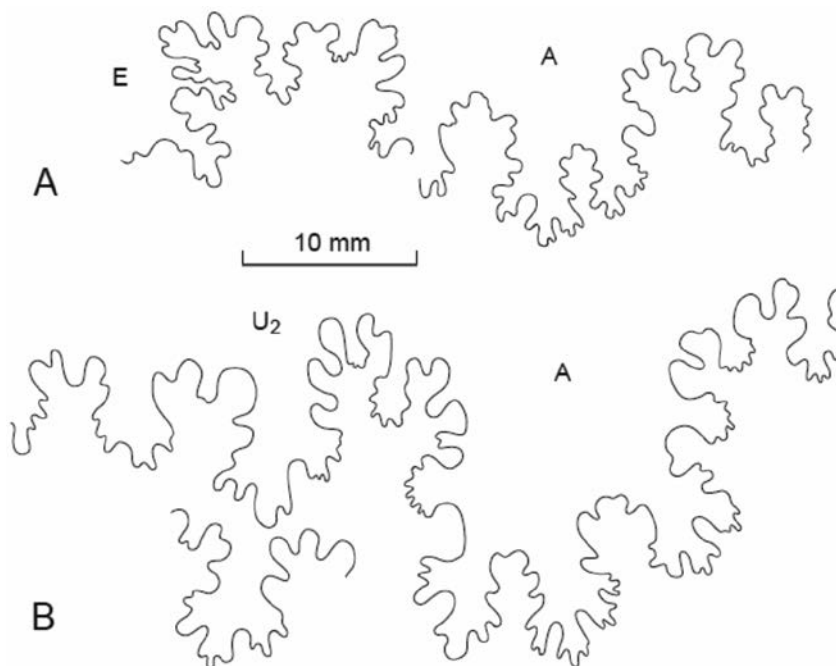
#### *Anahoplites planus* (Mantell, 1822) (Pl. 12, Figs 8–11; Text-figs 4A–C, 7A–C)

1822. *Ammonites planus* Mantell, p. 89, pl. 21, fig. 3.

2014. *Anahoplites planus planus* (Mantell, 1822); Klein, pp. 130, 133 (with synonymy).

**TYPE:** The neotype, by the subsequent designation of Spath (1925b, p. 137), is BMNH C. 34441, the original of Spath (1925b, pl. 12, fig. 8a), from the lower Middle Albian *Anahoplites intermedius* Zone Gault Clay of Folkestone, Kent, in southern England.





Text-fig. 8. External suture lines. A – *Semenoviceras michalskii* (Semenov, 1899), MWGUW ZI/63/0053, from Bed 5 of the Shakh-Bogota section. B – *Anahoplites rossicus* (Sinzow, 1910), MWGUW ZI/63/0363, from Bed D of the Koksyrtau-Aksyrtau section.

**MATERIAL:** MWGUW ZI/63/0572 and 0577 from Bed J of the Sulu-Kapy section. MWGUW ZI/63/0354 from Bed O and MWGUW ZI/63/1308 from Bed E; both of the Shyrkala-Airakty section.

**DESCRIPTION:** The specimens from Bed J of the Sulu-Kapy section range from 32 to 50 mm in diameter. Coiling is very involute, the small, very shallow umbilicus comprising around 16–19% of the diameter, the umbilical wall flattened and outward-inclined, the umbilical shoulder broadly rounded. The whorl section is very compressed, with a whorl breadth to height ratio of around 0.5, the greatest breadth just outside the umbilical shoulder, the flanks flattened to very feebly convex, the outer flanks convergent. The ventrolateral shoulders are narrowly rounded, the narrow venter flattened. Tiny, progressively strengthening, markedly prorsiradiate bullae perch on the umbilical shoulder. They give rise to pairs or groups of delicate ribs, and additional ribs intercalate. The ribs are very feebly falcoid, straight on the inner flank and very feebly concave on the outer flank, where they terminate in minute bullae, perched on the ventrolateral shoulder, alternating in position on either side of the venter, elongated towards the mid-venter to produce an incomplete chevron.

MWGUW ZI/63/0354 (Text-fig. 4A–C) is an internal mould of a 180° sector of phragmocone 62 mm

in diameter. The maximum preserved whorl height is 32 mm, the whorl breadth to height ratio 0.67, the greatest breadth low on the feebly convex inner flanks, the outer flanks flattened and convergent, the ventrolateral shoulders narrowly rounded, the venter very feebly convex. The umbilical margin is damaged, but an estimated eight weak primary ribs rise on the umbilical wall and develop into incipient, or very weak umbilical bullae. These give rise to feeble prorsiradiate ribs that efface on the outer flank to strengthen again on the outermost flank and develop into weak oblique ventrolateral clavi. The ribs are accompanied by delicate riblets; the venter is smooth between the clavi.

**DISCUSSION:** The whorl proportions and delicate, crowded ornament is typical of *Anahoplites* of the *planus* group, closely resembling, for example, that of specimens from the Kopet Dagh figured by Glazunova (1953, pl. 21, figs 1–5). Spath (1925b) introduced varieties *compressus*, *discoideus*, *gracilis*, and *sulcatus* of *planus*; synonymies are given by Klein (2014, pp. 131–134). Most are based on juveniles, and they may or may not represent a single variable species. The present material contributes little to the matter, although one, MWGUW ZI/63/0572 (Pl. 12, Figs 8, 9) has a sulcate venter as in Spath's variety *sulcatus*, and MWGUW ZI/63/0354 (Text-

fig. 4A–C) matches his *Anahoplites* aff. *planus* (Spath 1925b, pl. 12, fig. 9).

**OCCURRENCE:** In Western Europe the species ranges from the *intermedius* Zone to the *Mortoniceras pricei* Zone. The geographic distribution extends from southern England to France, Sardinia, Poland, Romania, Georgia, the Mangyshlak Mountains of western Kazakhstan, and the Kopet Dagh in Turkmenistan and Iran.

*Anahoplites rossicus* (Sinzow, 1910)

(Pl. 3, Figs 1–15; Pl. 4, Figs 1–11; Pl. 5, Figs 1–10; Pl. 6, Figs 1–8; Text-figs 8B, 9A–I)

1899. *Hoplites Deluci* Brongn.; Semenov, p. 121, pl. 4, fig. 6.  
 1910. *Desmoceras rossicus* Sinzow, p. 38, pl. 3, figs 8–15; pl. 4, fig. 15.  
 1910. *Desmoceras rossicus* var. *biplicata* Sinzow, p. 39, pl. 4, fig. 16.  
 1949. *Anahoplites rossicus* (Sinzow); Luppov *et al.*, p. 240, pl. 72, fig. 3; text-fig. 70.  
 1980. *Anahoplites rossicus* (Sinzow); Michailova, p. 87, text-fig. 5.  
 1983. *Anahoplites rossicus* (Sinzow); Michailova, text-fig. 87.  
 1996. *Anahoplites rossicus* (Sinzow); Marcinowski *et al.*, p. 20, pl. 11, fig. 1.  
 2011c. *Neanahoplites rossicus* (Sinzow); Cooper and Owen, p. 337.  
 2014. *Neanahoplites rossicus* (Sinzow, 1910); Klein, pp. 142, 143.

**TYPES:** Sinzow (1910, p. 38, pl. 3, figs 8–15; pl. 4, fig. 15) described and illustrated six specimens that he assigned to his *rossicus*; his figures are reproduced here as Text-fig. 9. The original of his pl. 3, figs 9, 10 (Text-fig. 9E, F) is here designated lectotype.

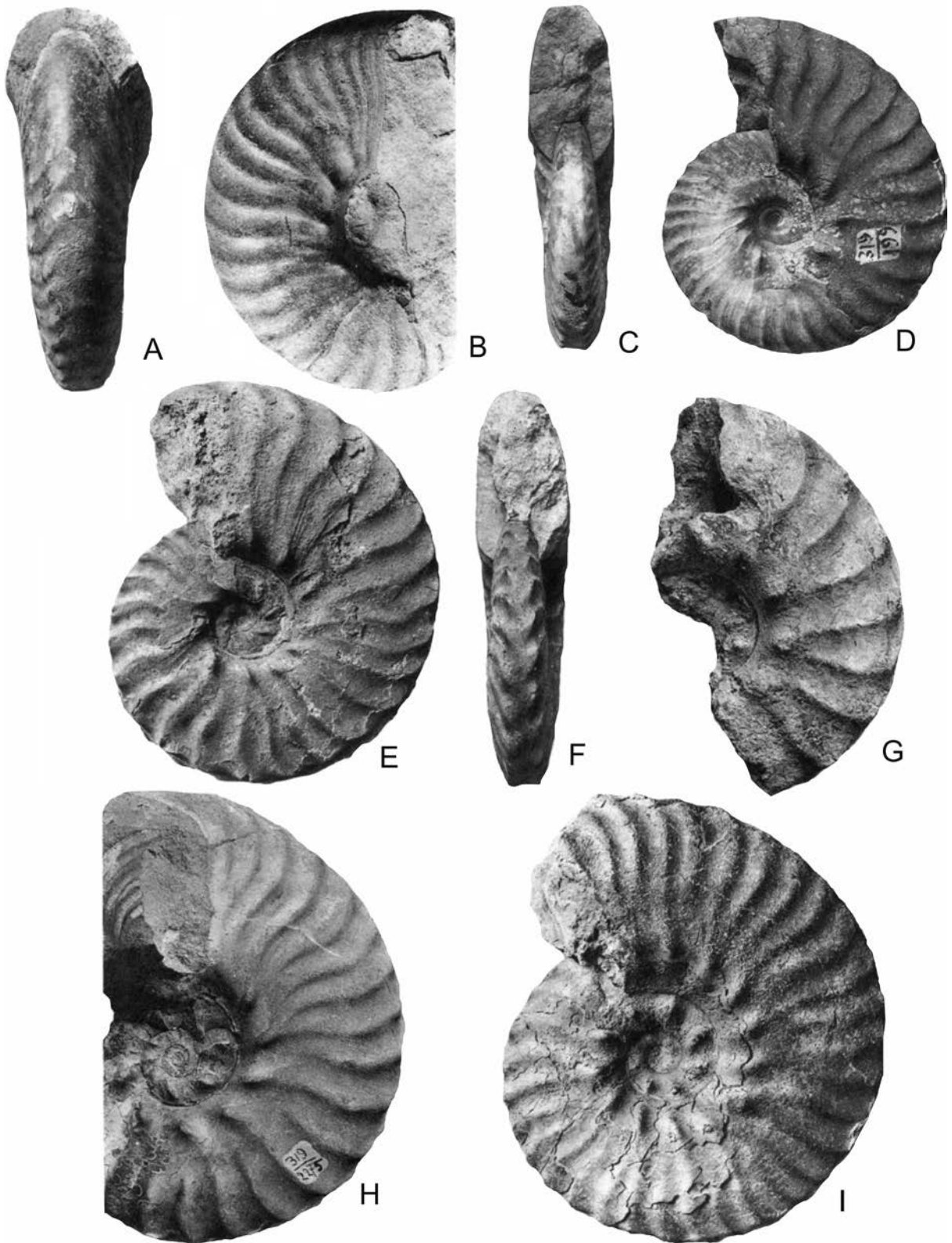
**MATERIAL:** There are abundant specimens. From Shyrkala-Airakty, Bed A: MWGUW ZI/63/0714; Bed E: 25 specimens, MWGUW ZI/63/1279, 1280, 1283–1290, 1292, 1293, 1296–1307; Bed G: 3 specimens, MWGUW ZI/63/0128, 0130, 0131, and some dubious fragments; Bed J: MWGUW ZI/63/0715. From Koksyrtau-Aksyrtau, Bed [-D]: 36 specimens, MWGUW ZI/63/0001, 0002, 0027–0030, 0031–0035, 0192, 0193, 0290–0292, 0295, 0298, 0300–0306, 0362–0366, 1220, 1221, 1237–1239; from a boundary level of beds [-D] and [-E]: 26 specimens, MWGUW ZI/63/0076, 0077, 0079–0083, 0085–0091, 0093–0095, 0753, 1615, 1623–1625. From Sulu-Kapy, Bed C: MWGUW ZI/63/0113, 0114, 0116; Bed E: nine

specimens: MWGUW ZI/63/0509–0517; Bed F: 21 specimens, MWGUW ZI/63/0308, 0309, 0311–0324, 0547–0549, 0551, 0552.

**DIMENSIONS:**

	D	Wb	Wh	Wb:Wh	U
MWGUW ZI/63/0313c	37.2 (100)	8.2 (22.0)	16.6 (44.6)	0.49	6.1 (16.4)
MWGUW ZI/63/0316ic	38.1 (100)	8.6 (22.6)	17.5 (45.9)	0.49	7.7 (20.2)
MWGUW ZI/63/0305c	40.9 (100)	11.4 (23.3)	18.8 (38.4)	0.61	9.3 (22.7)
MWGUW ZI/63/0319c	43.6 (100)	11.8 (27.1)	21.2 (48.6)	0.56	9.1 (20.9)
MWGUW ZI/63/0308c	44.9 (100)	11.4 (25.4)	20.2 (45.0)	0.56	9.7 (21.6)
MWGUW ZI/63/0028ic	54.3 (100)	13.7 (25.2)	25.5 (47.0)	0.54	12.3 (22.7)
MWGUW ZI/63/0365c	58.8 (100)	– (–)	27.0 (46.2)	–	15.3 (26.0)
MWGUW ZI/63/1239c	74.2 (100)	20.3 (27.4)	31.4 (42.3)	0.64	20.4 (27.5)
MWGUW ZI/63/0291ic	80.1 (100)	19.0 (23.7)	34.3 (42.8)	0.55	20.5 (25.6)
MWGUW ZI/63/0291ic	85.3 (100)	21.9 (25.7)	36.7 (43.0)	0.6	22.6 (26.5)
MWGUW ZI/63/0298ic	94.6 (100)	23.9 (25.3)	42.7 (45.1)	0.6	22.7 (24.0)
MWGUW ZI/63/0193ic	95.3 (100)	22.6 (23.6)	40.9 (42.9)	0.55	23.8 (25.0)

**DESCRIPTION:** Early phragmocone whorls are variable. The lectotype (Text-fig. 9E, F) and the paralectotypes figured by Sinzow (1910) as his pl. 3, figs 8 and 13 (Text-fig. 9A–D, G–I) have nuclei with strong umbilical tubercles visible in the umbilicus of their outer whorl. There are numerous robust individuals of this type in the present collections, notably those from Bed F of the Sulu-Kapy section. MWGUW ZI/63/0312 (Pl. 3, Figs 4, 5), 67 mm in diameter, is typical. Coiling is moderately evolute, with over 20% of the previous whorl covered, the umbilicus comprising 27% of the diameter, shallow, with a low, flattened, outward-inclined wall and a broadly rounded umbilical shoulder. The whorl section is compressed, with an intercostal whorl breadth to height ratio of 0.6 approximately, the flanks flattened to very feebly convex, converging to broadly rounded ventrolateral shoulders and a flattened venter. There are ten strong umbilical bullae on the outer whorl, rectiradiate at the smallest whorl height visible on the penultimate whorl, becoming distinctly prorsiradiate on the outer whorl, where they give rise to pairs of prorsiradiate ribs that strengthen across the flanks and are feebly concave on the outer flanks of the adapical part of the



Text-fig. 9. *Anahoplites rossicus* (Sinzow, 1910). Sinzow's original figures of the types, from "Mangyschlak", copies of: A, B – paralectotype, pl. 3, figs 14, 15; C, D – paralectotype, pl. 3, figs 11,12; E, F – the lectotype, pl. 3, figs 9, 10; G – paralectotype, pl.4, fig. 16 (var. *biplicata*); H – paralectotype, pl. 3, fig. 13; I – paralectotype, pl. 3, fig. 8.



outer whorl, and become feebly flexuous as size increases. The ribs link to strong clavi, perched on the ventrolateral shoulders, and alternating in position across the venter. MWGUW ZI/63/0307 (Pl. 3, Figs 8, 9) is a 180° whorl fragment 43 mm in diameter, with five umbilical bullae and 11 ribs at the ventrolateral shoulder that arise in pairs from the bullae, with an occasional intercalated rib. The ribs vary in direction; some are straight, others feebly flexed. This specimen has the ornament of Sinzow's variety *biplicata* (1910, pl. 4, fig. 16; Text-fig. 9G), as does MWGUW ZI/63/0311 (Pl. 3, Fig. 3) which overlaps in size with Sinzow's specimen.

At the other end of the variation spectrum are gracile nuclei, the flanks of the innermost whorls of which are near-smooth. These nuclei correspond to those of the paralectotype figured as Sinzow's (1910) pl. 3, fig. 11 (Text-fig. 9C, D). MWGUW ZI/63/0290 (Pl. 3, Figs 10–12) is typical. It has a maximum preserved diameter of 63.6 mm, and the gracile stage extends to the adapical 120° sector of the outer whorl, at a whorl height of 18 mm. The flanks of the penultimate whorl are smooth. Delicate, strongly prorsiradiate bullae appear at the beginning of the outer whorl, as do widely separated, delicate falcoid ribs. The ventrolateral shoulders are ornamented by closely spaced minute clavi (Pl. 3, Fig. 10; see also Pl. 3, Fig. 6). The nuclei of MWGUW ZI/63/0193 (Pl. 3, Fig. 7), ZI/63/0093 (Pl. 5, Figs 1–3) and ZI/63/0291 (Pl. 3, Figs 13–15) are further variants, to a degree passage forms to individuals with robustly ornamented nuclei.

There is a rapid transition to the strongly ribbed and tuberculate ornament of the later phragmocone. Here (Pl. 3, Fig. 12; Pl. 4, Figs 6, 8; Pl. 5, Figs 2, 4, 5), pairs of falcoid ribs arise from progressively strengthening umbilical bullae, the ribs straight and prorsiradiate on the inner flanks, strengthening progressively, concave and at their maximum strength on the outer flanks. They link to well-developed clavi, perched on the ventrolateral shoulders, slightly oblique, and directed towards the midline of the venter. Specimens such as MWGUW ZI/63/0001 (Pl. 4, Figs 3–5), 0193 (Pl. 3, Figs 6, 7), 0291 (Pl. 3, Figs 13–15), and 0298 (Pl. 4, Figs 9–11), are interpreted as retaining part of the adult body chamber. The ventrolateral clavi weaken and efface, and the venter rounds, the bullae weaken and efface, as do the inner flank ribs. Where shell material is preserved, as in MWGUW ZI/63/0001 (Pl. 4, Fig. 4), growth lines and delicate lirae are well-developed. Presumed complete smaller adults from Bed D of the Koksyrtau-Aksyrtau section are around 100 mm in diameter. There are also

larger adults up to 135 mm in diameter: MWGUW ZI/63/0002 (Pl. 6, Fig. 8) and ZI/63/1291 (Pl. 5, Fig. 10), but there is no clear distinction into dimorphs. The paralectotype figured by Sinzow (1910) as his pl. 3, figs 14, 15 (Text-fig. 9A, B), shows crowding of the flank ribs at the adaperatural end of the outer whorl, an apparent loss of the ventrolateral clavi and a rounding of the venter at a diameter of 68 mm, and appears to be a very small adult.

**DISCUSSION:** The distinctive ontogenetic changes shown by *rossicus* distinguish it from all others referred to *Anahoplites*.

**OCCURRENCE:** Upper Middle Albian of the Mangyshlak Mountains of western Kazakhstan.

#### Genus *Semenoviceras* Wright, 1996

**TYPE SPECIES:** *Hoplites Michalskii* Semenov, 1899 (pp. 120, 169, pl. 4, fig. 5), by original designation.

#### *Semenoviceras michalskii* (Semenov, 1899) (Pls 7–10; Text-figs 8A, 10, 11A–H, 12–15)

- 1899. *Hoplites pseudoauritus* Semenov, pp. 119, 168, pl. 4, fig. 4.
- 1899. *Hoplites Michalskii* Semenov, pp. 120, 169, pl. 4, fig. 5.
- 1899. *Hoplites deluci* Brongniart; Semenov, p. 121, pl. 4, fig. 7.
- 1899. *Hoplites pseudocoelenodus* Semenov, pp. 122, 169, pl. 4, fig. 7.
- 1899. *Hoplites Uhligi* Semenov, pp. 125, 169, pl. 5, fig. 1.
- 1899. *Hoplites pseudo-Fittoni* Semenov, 1899, pp. 124, 169, pl. 5, fig. 2.
- 1899. *Hoplites pseudo-Michelini* Semenov, 1899, pp. 126, 169, pl. 5, fig. 3.
- 1992. *Semenovites (Semenovites) tamalakensis* Saveliev, p. 155, pl. 48, fig. 2; text-fig. 37.
- 1996. *Semenovites michalskii* (Semenov 1899); Seyed-Emami and Immel, p. 17, pl. 5, figs 7, 10; pl. 6, fig. 3.
- 2014. *Planihoplites pseudoauritus* (Semenov, 1899); Klein, p. 144 (with synonymy).
- 2014. *Semenoviceras michalskii michalskii* (Semenov, 1899); Klein, pp. 145, 147 (with synonymy).
- 2014. *Planihoplites pseudocoelenotus* (Semenov, 1899); Klein, p. 144 (with synonymy).
- 2014. *Planihoplites uhligi uhligi* (Semenov, 1899); Klein, pp. 144, 145 (with synonymy).
- 2014. *Planihoplites uhligi pseudofittoni* (Semenov, 1899); Klein, pp. 144, 145 (with synonymy).



2014. *Planihoplites tamalakense* Savel'ev, 1992; Klein, pp. 146, 147 (with synonymy).  
 2014. *Semenoviceras michalskii* (Semenov, 1899); Mosavina *et al.*, p. 78, text-fig. 5b.

NAME OF THE SPECIES: As discussed below, I believe *michalskii*, *pseudoauritus*, *pseudocoelonodus*, *pseudofittoni*, and *pseudomichelini* of Semenov (1899) to be conspecific, and as first revising author, select *michalskii* as the name of the species.

TYPES: In the interests of clarity, details of the type material of all of the species described by Semenov (1899) that are regarded as synonyms of *michalskii* and their provenance is set out here.

Semenov (1899) described species from his localities Aïrakty and Tubé Koudouk. The former corresponds to Airakty as in Shyrkala-Airakty of Marcinowski *et al.* (1996, p. 12, text-figs 1, 6), and herein. Semenov refers jointly to Aïrakty and Tubé Koudouk; this suggests that Tube Koudouk is a locality close to the Shyrkala-Airakty area.

*Hoplites Michalskii* Semenov, 1899 (pp. 120, 169, pl. 4, fig. 5), was based on four specimens from Toubé Koudouk; the original of pl. 4, fig. 5 is designated lectotype.

*Hoplites pseudoauritus* Semenov, 1899 (pp. 119, 168, pl. 4, fig. 4) was based on two specimens from Toubé Koudouk; the original of pl. 4, fig. 4 is designated lectotype.

*Hoplites uhligi* Semenov, 1899 (pp. 125, 169, pl. 5, fig. 1) was based on a single specimen from Toubé Koudouk, which is the holotype by monotypy.

*Hoplites pseudofittoni* Semenov, 1899 (pp. 125, 169, pl. 5, fig. 2) was based on a single specimen from Toubé Koudouk, which is the holotype by monotypy.

*Hoplites pseudomichelini* Semenov, 1899 (pp. 126, 169, pl. 5, fig. 3) was based on two small fragments from Toubé Koudouk; the original of pl. 5, fig. 3 is designated lectotype.

*Hoplites pseudocoelonodus* Semenov, 1899 (pp. 122, 169, pl. 4, fig. 7). Semenov described his new species as follows in the French summary: "Quelques morceaux de tour, appartenant à une forme qu'on peut placer entre *Hopl. michalskii* n. f. et *Hopl. coelonodus* Seely. La description se trouve dans le text russe. La forme provient du Vraconien d'Aïrakty." The species is thus based on several specimens; the original of Semenov (1899, pl. 4, fig. 7) is designated lectotype. Cecca (1997, p. 338) stated that "This species was originally established on the basis of a single fragment", which he referred to as the holotype, but this is not the case.

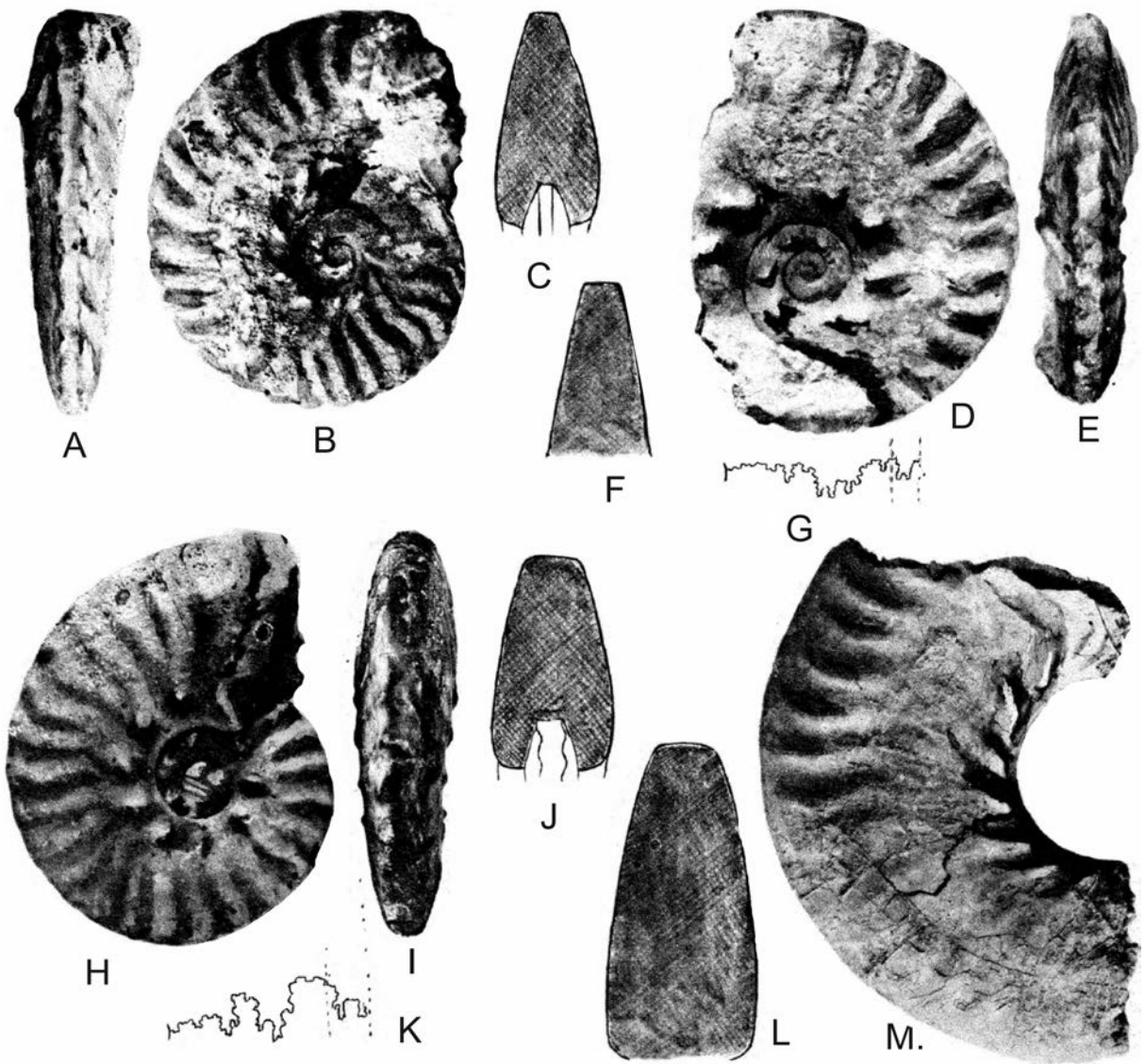
DESCRIPTION: In view of the large number of specimens assigned to *S. michalskii*, key assemblages from individual horizons and localities are described separately below.

A collection of 28 specimens from Bed 1 of the Shakh-Bogota section: MWGUW ZI/63/0050, 0054, 0055, 0062, 0065, 0068, 0102–110, 0281, 0522–0533, 0535–0537, 1766. Robust individuals are represented by MWGUW ZI/63/0054, 0055, 0103, 0108, 0109, 0530, and 0536, wholly septate, partially septate and body chamber fragments of juveniles. MWGUW ZI/63/0103 (Pl. 7, Figs 1, 2) is the best-preserved, an internal mould 78 mm in diameter, retaining a 90° sector of body chamber. Dimensions are as follows:

	D	Wb	Wh	Wb:Wh	U
MWGUW ZI/63/0103 at ic	75.7 (100)	18.6 (24.6)	36.8 (48.6)	0.51	17.9 (23.6)

Coiling is moderately involute, the umbilicus comprising 23.6% of the diameter, shallow, with a low, flattened, outward-inclined wall and broadly rounded umbilical shoulder. The intercostal whorl section is compressed, with a whorl breadth to height ratio of 0.51, the greatest breadth at the umbilical shoulder, the inner flanks feebly convex, the outer flanks flattened and convergent, the ventrolateral shoulders narrowly rounded, the venter feebly convex. Eleven/twelve low, broad, prorsiradiate ribs arise on the umbilical wall, and strengthen into small, widely separated umbilical tubercles. These are conical on the phragmocone, increase in size on the body chamber, and are modified into strongly prorsiradiate bullae. The bullae give rise to pairs of broad falcoïd ribs that strengthen across the flanks. They are straight and prorsiradiate on the inner flank, convex at mid-flank and concave on the outer flank, sweeping forwards on the outermost flank, and linking to long clavi, perched on the ventrolateral shoulders, and elongated parallel to the line of the mid-venter, across which they alternate in position. This individual corresponds to Semenov's *Hoplites deluci* (Text-fig. 10H–K).

MWGUW ZI/63/0068 (Pl. 7, Figs 5–7) is a more coarsely ornamented individual with a maximum preserved diameter of 47.4 mm. There are four large conical umbilical bullae on the 180° sector of body chamber. They give rise to two, or in one case three coarse falcoïd ribs with additional ribs intercalating to give a total of fourteen at the ventrolateral shoulder, where they terminate in strong clavi, perched on the ventrolateral shoulder. This specimen corresponds to the lectotype of *Hoplites pseudomichelini* of Semenov (1899) (Text-fig. 11D, E).

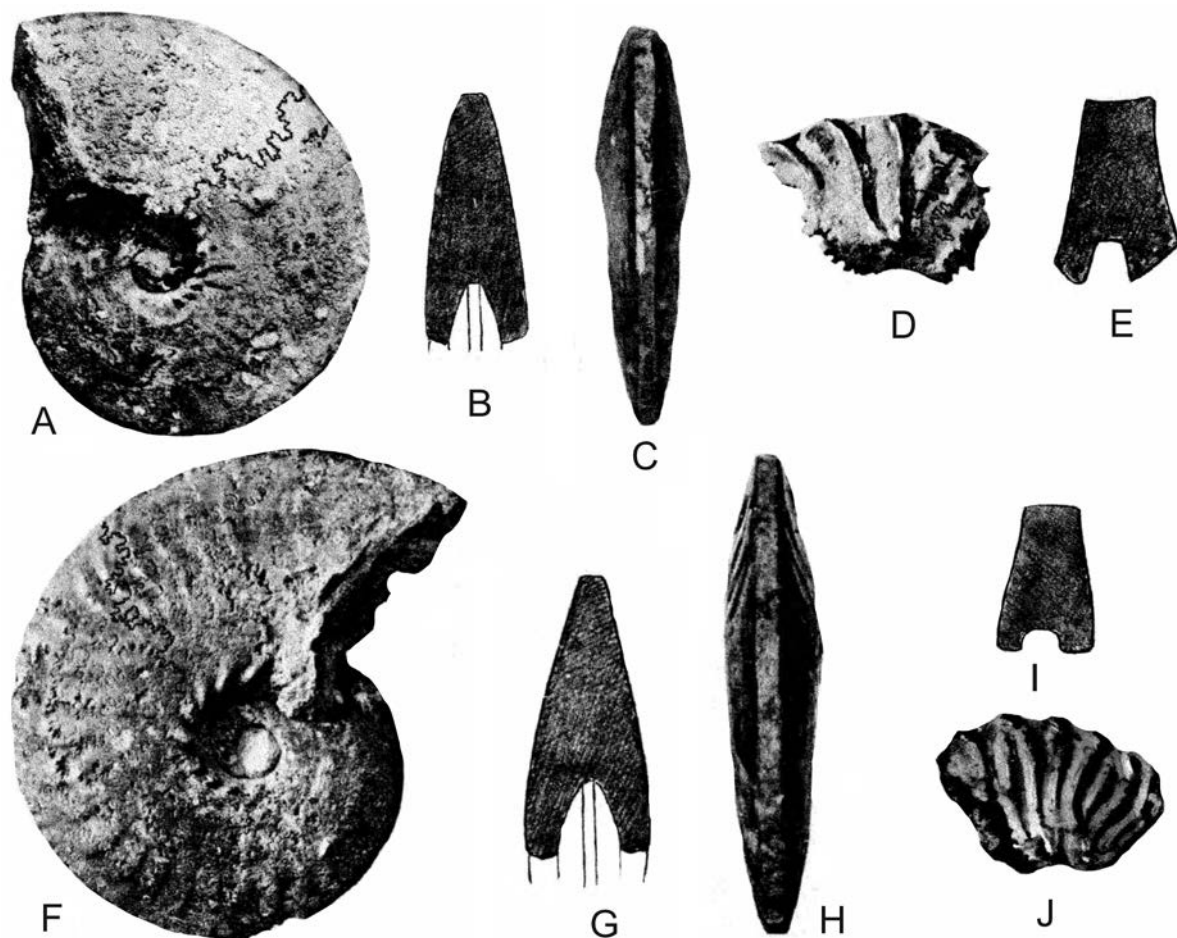


Text-fig. 10. *Semenoviceras michalskii* (Semenov, 1899). Copies of figures of species described by Semenov (1899). A–C – the lectotype of *Hoplites uhligi* Semenov, 1899, pl. 4, fig. 4; D–G – the lectotype of *Hoplites Michalskii* Semenov, 1899, pl. 4, fig. 5; H–K – *Hoplites Deluci* Brongniart, pl. 4, fig. 6; L, M – the lectotype of *Hoplites pseudocoelonodus* Semenov, 1899, pl. 4, fig. 7. The originals of A–K are from Toubé Koudouk; the original of L and M is from Airakty.

MWG UW ZI/63/0108 (Pl. 7, Figs 8, 9) is a 180° whorl sector with a maximum preserved diameter of 86 mm, retaining a 60° sector of phragmocone. There are four coarse umbilical tubercles on the half whorl, that on the phragmocone is conical, those on the body chamber are strongly prorsiradiate bullae. The tubercles give rise to pairs of ribs with a third rib feebly attached in some cases, and there are additional intercalated ribs, to give a total of sixteen ribs that link to strong clavi perched on the ventrolateral shoulder. This fragment corresponds closely to the

lectotype of Semenov's *Hoplites michalskii* (Text-fig. 10D–G).

MWG UW ZI/63/0062 (Pl. 7, Figs 3, 4) is an individual with weaker ornament, 67.2 mm in diameter, retaining a 60° sector of phragmocone. The intercostal whorl breadth to height ratio is 0.53. There are an estimated four umbilical tubercles, conical on the phragmocone and transitional to bullae on the body chamber. The falcoid ribs are low, broad and flat, number 13 at the ventrolateral shoulder, and are accompanied by delicate riblets and lirae in the interspaces.



Text-fig. 11. Copies of figures of species described by Semenov (1899). A–C – the holotype of *Hoplites pseudo-Fittoni* Semenov, 1899, pl. 5, fig. 1; D, E – the lectotype of *Hoplites pseudo-Michelini* Semenov, 1899, pl. 5, fig. 3; F–H – the holotype of *Hoplites Uhligi* Semenov, 1899; I, J – *Hoplites auritus* Sow., pl. 4, fig. 3. The originals are from Tubé Koudouk.

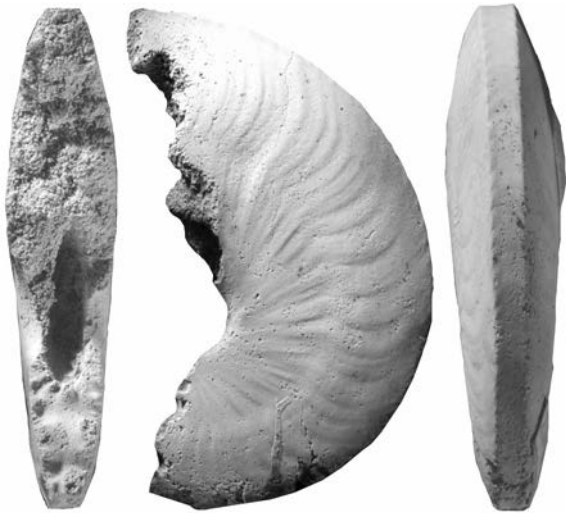
There are a series of body chambers with progressively weakening ornament. MWGUW ZI/63/0104 (Pl. 7, Figs 10, 11) is a body chamber 81.5 mm in diameter, with a whorl breadth to height ratio of 0.41. The small umbilical bullae give rise to groups of delicate straight prorsiradiate riblets and lirae that link in groups at broad, low, crescentic concave ribs on the outer flank, with delicate lirae on their surfaces and on the interspaces. The ventrolateral shoulders are minutely crenulated, with tiny clavi, more numerous than the ribs. The style of ornament of this specimen corresponds closely to that of the lectotype of Semenov's *Hoplites pseudocoelenotus* (Text-fig. 10L, M).

The largest specimen in the Shakh-Bogota assemblage, MWGUW ZI/63/0110 (Pl. 8, Figs 9, 10), is a body chamber 122 mm in diameter. Here, the bullae give rise to groups of delicate straight, prorsiradiate

riblets/striae which join in groups at the broad concave ribs on the outer flank; in some cases one extends across the adapical side of the rib. There are minute clavi on the ventrolateral shoulders, more numerous than the crescentic ribs. Towards the adapertural end of the body chamber the venter rounds, and the sharp ventrolateral shoulders and clavi are lost, changes interpreted as indications of proximity to the adult aperture.

The earliest growth stage of *michalskii* seen is represented by MWGUW ZI/63/0050 (Text-fig. 12), an internal mould of the phragmocone of a gracile individual 23.7 mm in diameter. Coiling is involute, the shallow umbilicus comprising 22% of the diameter, with a low, flattened, outward-inclined umbilical wall and very narrowly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.5, the flanks very feebly convex, the





Text-fig. 12. *Semenoviceras michalskii* (Semenov, 1899), MWGUW ZI/63/0050, from Bed 3 of the Shakh-Bogota section. Figures are  $\times 2$ .

outer flanks converging to sharp ventrolateral shoulders, the venter feebly concave between. Ornament is of crowded delicate falcoïd riblets that arise singly or in pairs at the umbilical shoulder and are straight and prorsiradiate on the inner flank and concave on the outer flank, sweeping forwards to link to minute feebly oblique clavi, perched on the ventrolateral shoulders. Other gracile juveniles show a range of variation. MWGUW ZI/63/0102 (Pl. 8, Figs 1, 2), a body chamber 64 mm in diameter, has a whorl breadth to height ratio of 0.45, with weak and low but well-differentiate falcoïd ribs and riblets/lirae. In contrast, MWGUW ZI/63/0533 (Pl. 8, Figs 5, 6), 57 mm in diameter has two quite distinct ontogenetic stages. The first, extending to a whorl height of 25 mm approximately, consists of minute strongly prorsiradiate bullae that give rise to groups of falcoïd riblets/lirae that link to minute clavi on the sharp ventrolateral shoulders; the succeeding whorl sector, in contrast, develops low, broad, widely separated falcoïd ribs of more normal type. In MWGUW ZI/63/0261, a phragmocone 62 mm in diameter, delicate, feebly falcoïd ornament superimposed on weak falcoïd ribs, extends throughout, as in *Hoplites uhligi* and *pseudofittoni* of Semenov (1899). These co-occurring variants are the basis for the conclusion that Semenov's species referred to above are all juveniles of a variable *Semenoviceras michalskii*, as hinted at by Marcinowski *et al.* (1996, p. 36).

Another collection from Bed 1 of the Shakh-Bogota section consists of 55 specimens: MWGUW ZI/63/0048, 0049, 0053, 0057–0061, 0276, 0278–80,

0282–0287, 0296, 0297, 0682–0698, 0700, 0703, 0704, 1644, 1645. All are body chambers, all with ornament like that of Semenov's (1899) *pseudocoelendus* (Text-fig. 10L, M). The three largest, MWGUW ZI/63/0287, 0689, and 0164, show rounding of the venter at 114, 107, and 119 mm respectively, and are interpreted as complete or near-complete microconchs. MWGUW ZI/63/0164 is associated with a specimen of *Gnesioceramus anglicus*.

Collection from Beds 1 or 2 at Shakh-Bogota consists of five specimens, MWGUW ZI/63/0518–0522, one of which, 0520, is a microconch 130 mm in diameter.

Collection from Bed 2 at Shakh-Bogota comprises five specimens, MWGUW ZI/63/0117, 0118, 0124 (a crushed adult, with an estimated original diameter of around 180 mm), 0125, and 0127.

Collection from Bed 1A at Shyrkala-Airakty, comprises fifteen specimens: MWGUW ZI/63/0251–54, 0256, 0257, 0262–0264, 1621, 1622, 1634, 1636, 1637. Three specimens show broadening and rounding of the venter, and may be adults, ZI/63/1621, at 133 mm in diameter, ZI/63/0253, at 165 mm in diameter, and ZI/63/0262, also 165 mm in diameter.

Collection from Bed 1B at Shyrkala-Airakty, is composed of 37 specimens: MWGUW ZI/63/0003, 0004, 0006–13, 0015–23, 0025, 0026, 0041–0047, 0072–0075, 0092–0111a and b, 0250, 0274, 0275, 0294, 0329, and 1635. Dimensions of selected specimens are as follows:

	D	Wb	Wh	Wb:Wh	U
MWGUW ZI/63/0023	90.4 (100)	22.1 (24.4)	45.9 (50.8)	0.48	17.6 (19.4)
MWGUW ZI/63/0010	107.5 (100)	24.7 (23.0)	48.3 (44.9)	0.51	21.9 (20.3)
MWGUW ZI/63/0006	113.9 (100)	28.4 (24.9)	53.8 (47.2)	0.53	24.7 (21.7)
MWGUW ZI/63/0046	157.0 (100)	39.1 (24.9)	72.9 (46.4)	53.6	31.0 (19.7)

The majority of specimens are body chambers, a few of which retain whole or fragmentary internal moulds of the phragmocone in associated matrix. Most record the penultimate growth stage, with small prorsiradiate umbilical bullae that give rise to pairs of falcoïd ribs, straight and prorsiradiate on the inner half of the flanks, strengthening progressively, reaching maximum strength at mid-flank, where they flex back and are convex before flexing forwards, broadening and weakening on the outer flanks and linking to delicate slightly oblique clavi perched on the sharp to narrowly rounded ventrolateral shoulders. In some specimens the clavi are lost on what is interpreted as the adapical part of the adult body chamber, the





Text-fig. 13. *Semenoviceras michalskii* (Semenov, 1899), MWGUW ZI/63/0275, from Bed 1B of the Shyrkala-Airakty section. Figures are  $\times 1$ .

ribbing weakening and effacing, the ventrolateral shoulders rounding, the venter becoming feebly convex. MWGUW ZI/63/0275 (Text-fig. 13) is a subadult body chamber with well-developed falcoid ribs, small oblique clavi on the ventrolateral shoulders on the adapical part, thereafter lost on the adapertural part, the venter concave. MWGUW ZI/63/0329 (Text-fig. 14), 185 mm in diameter is interpreted as an adult macroconch; MWGUW ZI/63/0060, 116 mm in diameter, as a micrococh, The majority of specimens have a relatively subdued ornament.

Koksyrtau-Aksyrtau, Bed A, comprises six specimens: MWGUW ZI/63/0037, 0242, 0330; single specimen, MWGUW ZI/63/0045, comes from the equivalent bed of the Kush Section. Koksyrtau-Aksyrtau, Bed [-A] comprises: MWGUW ZI/63/1219, 1241, and 1244. MWGUW ZI/63/1219 shows rounding of the venter at 150 mm diameter. Koksyrtau-Aksyrtau,

Bed [-B], 20 specimens, MWGUW ZI/63/0081, 0289, 0331, 1213–1215, 1223–1226, 1228, 1236, 1243, 1245–1247, 1249–1252. Of these MWGUW ZI/63/1236 (Text-fig. 15) is a complete macroconch body chamber plus the adapertural four camerae; lacking ornament, the venter is rounded, and, distinctively, the umbilical wall is concave, with a narrowly rounded umbilical shoulder. MWGUW ZI/63/0331 and 1213 are smooth fragments of macroconch body chamber, and ZI/63/0289 is a possible subadult macroconch body chamber, retaining weak ornament throughout, with a maximum preserved diameter of 157 mm.

DISCUSSION: From the description of these collections, nuclei from Shakh-Bogota are seen to show wide variation, linking robustly ribbed and tuberculate individuals (Pl. 7, Figs 5–9) to gracile ones (Pl. 7, Figs 10, 11), on the basis of which the types



Text-fig. 14. *Semenoviceras michalskii* (Semenov, 1899), MWGUW ZI/63/0329, an adult macroconch 180 mm in diameter and a fragmentary juvenile from Bed 1B of the Shyrkala-Airakty section. The figure is  $\times 1$ .

of *pseudoauritus*, *pseudomichelini*, *uhligi*, *pseudofittoni*, and *pseudocoelonodus*, together with the figured specimen of *Hoplites deluci* of Semenov (1899) are interpreted as synonyms of a variable *michalskii*.

These small individuals are interpreted as the inner whorls of the abundant body chambers, amongst which ornament of the type shown by the lectotype of *pseudocoelonodus* dominates (Pls 9 and 10). There



Text-fig. 15. *Semenoviceras michalskii* (Semenov, 1899), MWGUW ZI/63/1236, the largest specimen seen, an adult macroconch body chamber 220 mm in diameter, from Bed B of the Koksyrtau-Aksyrtau section. The figure is reduced to  $\times 0.8$ .

are a few specimens, including the largest in the collections, that are characterised by a loss or weakening of flank ornament, loss of angular ventrolateral shoulders and clavi and rounding of the venter on

the adapertural part of the body chamber that are interpreted as adults of both macroconchs and microconchs.

The holotype of *Anahoplites litschkovi* Saveliev,



1960 (p. 177, pl. 41, fig. 1; text-fig. 32) finds a match in MWGUW ZI/63/0108 (Pl. 7, Figs 8, 9).

None of the present specimens match *Anahoplites michalskii* var. *magnituberculatum* Luppov, 1961 (p. 198, pl. 5, fig. 1; text-fig. 11).

**OCCURRENCE:** Lower Upper Albian, dated as *cristatum* Zone on the basis of a record from southern England (Cooper and Owen 2011c, p. 337). The Mangyshlak Mountains of western Kazakhstan, the Kopet Dagh in southern Turkmenistan and northern Iran, central Iran, and southern England, with a possible record from Sarthe in France (Juignet and Kennedy in Juignet *et al.* 1983, p. 201, pl. 1, figs 3, 4).

*Semenoviceras baisunense* (Luppov, 1961)  
(Text-fig. 16)

1961. *Anahoplites* (?) *baisunensis* Luppov, p. 200, pl. 6, fig. 1; text-fig. 14.

1996. *Semenoviceras baisunensis* (Luppov); Seyed-Emani and Immel, p. 17, pl. 6, fig. 4.

1997. *Semenovites baisunensis iranense* Amédro, Destombes and Teherani, p. 976, pl. 1, fig. 1.

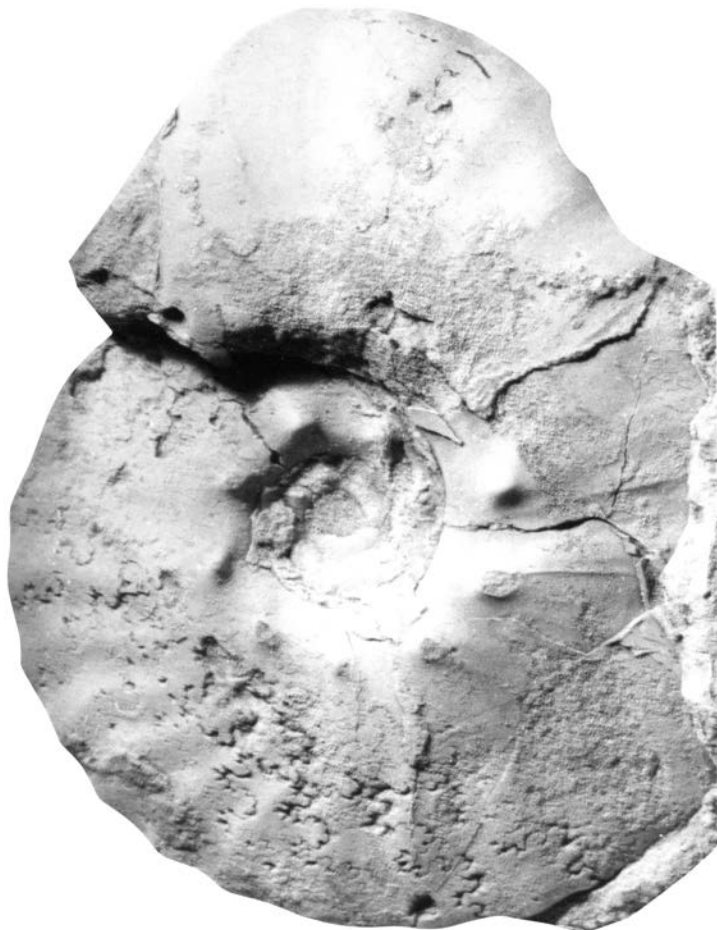
2011c. *Semenoviceras baisunense* (Luppov); Cooper and Owen, p. 337.

2014. *Semenoviceras baisunense baisunense* (Luppov, 1961); Klein, pp. 145, 146.

2014. *Semenoviceras baisunensis iranense* Amédro, Destombes and Teherani; Klein, pp. 145, 146.

**TYPE:** The holotype, by original designation, is specimen 18/9327 (Tshernyshev Collection, VSEGEI, St. Petersburg; Russia), the original of Luppov (1961, pl. 6, fig. 1), from the Upper Albian of Audat, Hisar Range, Uzbekistan.

**MATERIAL:** MWGUW ZI/63/0005, from Bed 1B of the Shyrkala-Airakty section, lower Upper Albian, *michalskii* Zone.



Text-fig. 16. *Semenoviceras baisunense* (Luppov, 1961), MWGUW ZI/63/0005, from Bed 1B of the Shyrkala-Airakty section. The figure is  $\times 1$ .



DESCRIPTION: MWGUW ZI/63/0005 (Text-fig. 16) is an internal mould of a phragmocone 95 mm in diameter, and part of one flank of a further 180° sector of body chamber. The umbilicus comprises an estimated 18–20% of the diameter of the phragmocone, size increasing on the succeeding fragment of body chamber. It is shallow, with a flattened, outward-inclined wall, and broadly rounded umbilical shoulder. The whorl section is compressed, but the relative proportions cannot be established because of the fragmentary nature of the specimen. The flanks are flattened and convergent in intercostal section, the ventrolateral shoulders very narrowly rounded, the narrow venter flattened. There are nine strong and progressively strengthening, widely separated umbilical bullae on the outer whorl of the phragmocone. They give rise to pairs of low, broad, falcoid ribs, straight and prorsiradiate on the inner flank, concave on the outer flank, and terminating in well-developed clavi, perched on the ventrolateral shoulder, and elongated parallel to the line of the mid-venter. The umbilical bullae persist to the adapertural end of the body chamber fragment, on which the flank ornament weakens markedly.

DISCUSSION: The present specimen is only the fourth member of this species to be figured. The strong umbilical bullae, low phragmocone ribs and effacement of flank ornament on the body chamber match those features of the holotype, of which the present specimen is interpreted as a compressed variant. *Semenovites baisunensis* var. *iraniense* Amédro, Destombes and Teherani, 1977 (p. 976, pl. 1, fig. 1) differs in minor details of whorl proportions and ornament.

OCCURRENCE: Lower Upper Albian, Turkmenistan, central Iran, and the Mangyshlak Mountains of western Kazakhstan.

#### Genus *Euhoplites* Spath, 1925a

TYPE SPECIES: *Euhoplites truncatus* Spath, 1925a (p. 82), by original designation.

#### *Euhoplites ochetonotus* (Seeley, 1864) (Text-fig. 17)

1864. *Ammonites ochetonotus* Seeley, p. 276.

2014. *Euhoplites ochetonotus ochetonotus* (Seeley, 1864); Klein, pp. 62, 67 (with synonymy).

TYPE: The lectotype, by the subsequent designa-

tion of Spath (1930, p. 288), is no. B. 42149 in the collections of the Sedgwick Museum, Cambridge, from the Red Chalk of Hunstanton, Norfolk, eastern England. The venter was figured by Spath (1930, pl. 29, fig. 1a).

MATERIAL: MWGUW ZI/63/1212, from Bed [-D] of the Koksyrtau-Aksyrtau section, ?*michalskii* Zone.

#### DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
MWGUW ZI/63/1212 at	165.0 (100)	– (–)	79.9 (48.4)	–	32.0 (19.4)

DESCRIPTION: The specimen is a large internal mould of an adult, the final septum at a diameter of 154 mm. Coiling is moderately involute, with approximately 45% of the previous whorl covered, the umbilicus shallow, with a flattened, outward-inclined wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.5 approximately, the whorl section trapezoidal, the feebly convex flanks convergent, with the greatest breadth below mid-flank. The venter is concave between narrowly rounded ventrolateral shoulders. Twenty ribs arise on the umbilical wall of the outer whorl of the phragmocone, and strengthen into small prorsiradiate bullae, perched on the umbilical shoulder. These give rise to pairs of delicate sinuous prorsiradiate ribs, with occasional intercalatories, and a third rib may be tenuously associated with a bullate pair. The ribs are straight on the inner flank, feebly convex at mid-flank, and concave on the outer flank. The ventrolateral shoulders are smooth. The body chamber lacks ornament.

DISCUSSION: Spath (1930, p. 288) noted five specimens of *ochetonotus* in Seeley's collection in the Sedgwick Museum, and stated that the largest "is now taken as type", which I regard as a valid lectotype designation; it is referred to as the lectotype in the explanation of the table of measurements. In the explanation of his plate 27, Spath (1930) refers to the same specimen as the neotype, and figured a second Seeley specimen which he referred to as a paratype. The flank of the latter specimen (Spath 1930, pl. 29, fig. 1b) has ornament on the adapical part of the outer whorl that compares well with that of the phragmocone of the present specimen. Spath's variety *nodosa* (1930, p. 289, pl. 28, fig. 9) is simply a more strongly ribbed and tuberculate individual, the style of the ornament otherwise comparable to that of the present specimen.



Text-fig. 17. *Euhoplites ochetonotus* (Seeley, 1864), MWGUW ZI/63/1212, from Bed D of the Koksyrtau-Aksyrtau section. The figure is reduced to  $\times 0.8$ .

OCCURRENCE: Lower Upper Albian, *cristatum* and *pricei* zones, southern England, France, Chechnya in Russia, and, possibly Germany; *michalskii* Zone? of the Mangyshlak Mountains of western Kazakhstan.

*Euhoplites* cf. *trapezoidalis* Spath, 1930  
(Text-fig. 18)

compare:

1930. *Euhoplites trapezoidalis* Spath, p. 285, pl. 28, fig. 1; pl. 30, fig. 12.

1930. *Euhoplites trapezoidalis* var. *formosa* Spath, p. 285, pl. 30, fig. 11.

2014. *Euhoplites trapezoidalis trapezoidalis* Spath, 1930; Klein, pp. 63, 71 (with synonymy).

2014. *Euhoplites trapezoidalis formosus* Spath, 1930; Klein, pp. 62, 72.

MATERIAL: MWGUW ZI/36/1432, from Bed 1A of the Shyrkala-Airakty section, lower Upper Albian, *michalskii* Zone.

DESCRIPTION: The specimen is a  $180^\circ$  sector of body chamber 127 mm in diameter, retaining limonitised shell. The umbilicus is shallow, and comprises 20–25% of the diameter, with a flattened, outward-inclined wall and feebly convex umbilical shoulder. The intercostal section is compressed trapezoidal, the flanks very feebly convex, convergent, the ventrolateral shoulders narrowly rounded, the venter markedly



Text-fig. 18. *Euhoplites* cf. *trapezoidalis* Spath, 1930, MWGUW ZI/63/1432, from Bed 1A of the Shyrkala-Airakty section. The figure is reduced to  $\times 0.9$ .

concave. Low, widely separated primary ribs arise at the umbilical seam, and strengthen into strong, conical tubercles on the inner flank. These tubercles give rise to pairs of strong, narrow, prorsiradiate concave ribs, and additional ribs intercalate at mid-flank. The ribs link in groups of two or three at large, oblique, prorsiradiate clavi that alternate in position on either side of the venter. They are borne on a blunt, rounded ridge on either side of a concave venter.

DISCUSSION: There are relatively few published figures of *Euhoplites* the size of the present specimen. Of these, the closest is the holotype of *Euhoplites trapezoidalis* Spath, 1930 (pl. 28, fig. 1), and it is with this species that the present specimen is compared.

OCCURRENCE: As for material. Where well-dated,

*Euhoplites trapezoidalis* is lower Upper Albian, *crisatum* Zone and correlatives. The geographic distribution extends from southern England to northern France, northern Germany, and, possibly, the Mangyshlak Mountains of western Kazakhstan.

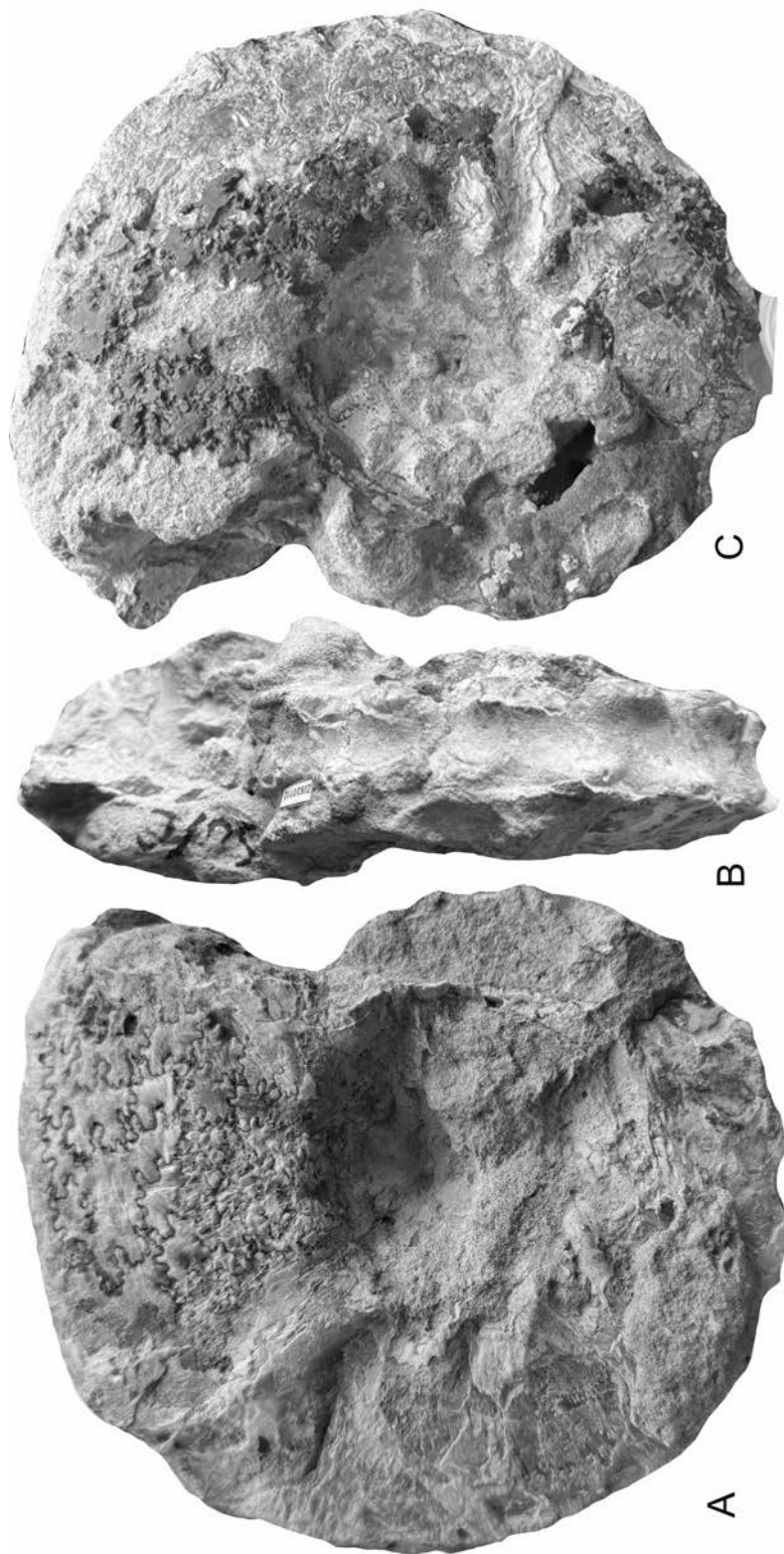
*Euhoplites* sp. A.

(Text-fig. 19)

MATERIAL: MWGUW ZI/63/0112, from Bed C of the Sulu-Kapy section.

DESCRIPTION: The specimen is a worn and battered phragmocone 154 mm in diameter, infilled by barite, with areas of barite-replaced shell. Coiling is involute, the umbilicus comprising an estimated 25% of the diameter, deep, with an outwards-inclined wall





Text-fig. 19. *Euhoplites* sp. A, MWGUW ZI/63/0112, from Bed C of the Sulu-Kapy section. Figures are reduced to  $\times 0.7$ .



and broadly rounded umbilical shoulder. The whorl section is compressed, with an intercostal whorl breadth to height ratio of 0.86 approximately, the greatest breadth at the umbilical shoulder, the whorl section trapezoidal, with feebly convex, convergent flanks, narrowly rounded ventrolateral shoulders and a concave venter. Ornament is poorly preserved. On the penultimate whorl, there are six massive umbilical bullae per half whorl. There are seven strong prorsiradiate umbilical bullae per half whorl on the outer whorl, and traces of low ribs on the flanks, but the pattern cannot be established. The ventrolateral shoulders bear strong clavi that alternate in position on either side of the sulcate venter, and are approximately twice as numerous as the umbilical bullae.

DISCUSSION: The massive umbilical bullae of the penultimate whorl of this specimen are distinctive, and suggest the presence of a further species of *Euhoplites*.

OCCURRENCE: As for material.

#### Genus *Dimorphoplites* Spath, 1925a

TYPE SPECIES: *Ammonites biplicatus* Mantell, 1822 (p. 91, pl. 22, fig. 6), by the original designation of Spath (1925a, p. 81).

#### *Dimorphoplites beresovkaensis* Glazunova, 1968 (Pl. 12, Figs 12–16)

1968. *Dimorphoplites beresovkaensis* Glazunova, p. 316, pl. 74, figs 2, 3.

1973. *Dimorphoplites beresovkaensis* Glazunova; Glazunova, p. 151; pl. 118. Figs 1–3; pl. 119, figs 1–3; pl. 120, figs 1–3.

2014. *Dimorphoplites beresovkaensis* Glazunova, 1968; Klein, pp. 98, 99 (with synonymy).

TYPE: The lectotype, by the subsequent designation of Glazunova (1973, p. 151), is the original of Glazunova (1968, pl. 74, fig. 2), from the Middle Albian of the Sarak-Saldy ravine of the Beresovka River, Povolzhe, Russia.

MATERIAL: MWGUW ZI/63/0575, 0580, 0581, and 0583, from Bed J of the Sulu-Kapy section.

DESCRIPTION: MWGUW ZI/63/0580 (Pl. 12, Fig. 16) is an internal mould of a nucleus 33.3 mm in

diameter. Coiling is moderately involute, the umbilicus comprising around 28% of the diameter, shallow, with a low, outward-inclined umbilical wall and broadly rounded umbilical shoulder. The whorl section is compressed, but the relative proportions cannot be established. On the adapical half on the outer whorl, seven ribs arise at the umbilical seam, strengthen across the umbilical wall, and develop into delicate bullae, perched on the outer margin of the umbilical shoulder. These give rise to pairs of delicate prorsiradiate ribs, and additional ribs intercalate, the ribs strengthening, sweeping forwards across the outer flanks, and linking to delicate clavi, perched on the ventrolateral shoulder. The clavi alternate in position on either side of the venter, and project forwards at an angle to the mid-line of the venter, which is smooth between the clavi. The ornament strengthens markedly on the adapertural half whorl of the nucleus, with pairs of ribs arising from the umbilical bullae with single ribs intercalating between. MWGUW ZI/63/0575 (Pl. 12, Figs 12, 13) is a 60° fragment of the succeeding whorl, and part of the body chamber. The maximum preserved intercostal whorl height is 22 mm approximately. Pairs of strong, narrow, prorsiradiate ribs arise from strong umbilical bullae and link to very strong, oblique ventrolateral clavi. MWGUW ZI/63/0581 (Pl. 12, Figs 14, 15) is an internal mould of a phragmocone fragment with a maximum preserved intercostal whorl height of 22.5 mm approximately. The whorl section is compressed, the whorl to breadth to height ratio 0.8. Four widely separated ribs arise at the umbilical seam, and strengthen across the umbilical wall and inner flank, where they develop into strong, pinched, narrow bullae at mid-flank. These give rise to single strong, narrow, prorsiradiate ribs, with a second adapical rib loosely attached. The ribs link to very large, pinched oblique clavi that alternate in position on either side of the smooth venter.

DISCUSSION: Of described *Dimorphoplites* species, the coarse, irregular, hypernodose ornament of the larger fragment resembles that of the even larger fragments of *beresovkaensis* figured by Glazunova (1968, pl. 74, figs 2, 3). There are also similarities to the adult body chamber fragment from Dunton Green in Kent, southern England, figured by Spath (1926a, pl. 15, fig. 2) as *Dimorphoplites?* aff. *silenus*.

OCCURRENCE: Middle Albian. The geographic distribution is the Mangyshlak Mountains of western Kazakhstan and Povolzhe on the eastern part of the Russian Platform.

*Dimorphoplites* sp. juv. cf. *niobe* Spath, 1926a  
(Text-fig. 7D, E)

1925b/1926a. *Dimorphoplites niobe* Spath, p. 154 (1926a), pl. 12, figs 7a–d (1925b); text-fig. 44a (1926a).

2014. *Pseudohoplites niobe* (Spath, 1926); Klein, p. 97 (with synonymy).

MATERIAL: MWGUW ZI/63/0134, from Bed G of the Shyrkala-Airakty section.

DIMENSIONS:

	D	Wb	Wh	W:Wh	U
MWGUW ZI/63/0134c	31.6 (100)	8.9 (28.2)	15.5 (49.0)	0.57	5.3 (16.8)

DESCRIPTION: MWGUW ZI/63/0134 (Text-fig. 7D, E) is a wholly septate internal mould. Coiling is involute, the small, shallow umbilicus comprising 16.8% of the diameter. The umbilical wall is flattened, the umbilical shoulder broadly rounded. The whorl section is compressed, the intercostal section with feebly convex, convergent flanks, the ventrolateral shoulders broadly rounded, the venter flattened. There are five widely separated, progressively strengthening umbilical bullae on the adapertural half of the outer whorl. They give rise to pairs of feebly and variably prorsiradiate falcoid ribs, some tenuously connected to a bulla, whilst additional ribs intercalate, to give a total of sixteen at the ventrolateral shoulder. The ribs strengthen markedly on the outer flank, and link to well-developed ventrolateral clavi that alternate in position on either side of the venter and are directed towards the mid-line of the venter. The suture (Text-fig. 20) is moderately incised, with a broad, deep A.

DISCUSSION: The specimen is compared to *Dimor-*

*phoplites niobe* on the basis of similarities to juveniles of comparable size assigned to this species by Spath (1926a, p. 154), notably juveniles figured by him (Spath 1925b, pl. 12, figs 7b, c).

OCCURRENCE: Upper Middle Albian, *daviesi* Zone and correlatives, southern England, Pas-de-Calais and Aube in France, western Austria, Romania, the Mangyshlak Mountains in western Kazakhstan, the Kopet Dagh in northern Iran and southern Uzbekistan.

OCCURRENCE: As for material.

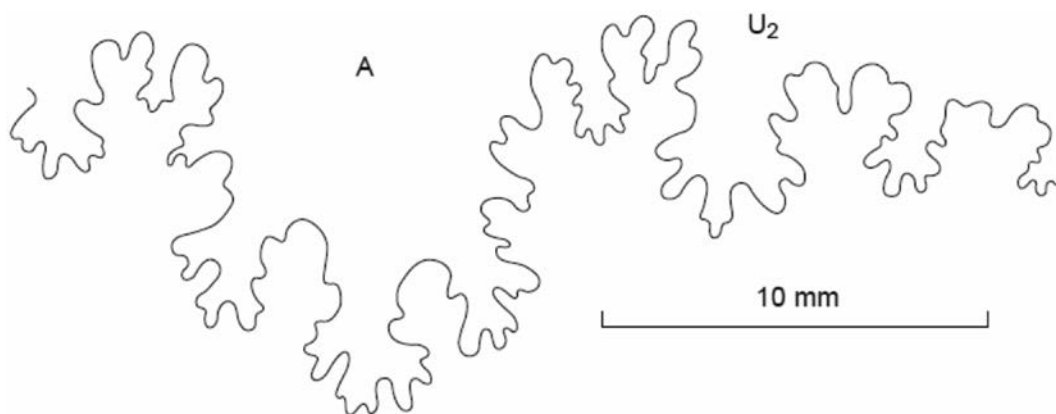
Genus and Subgenus *Epihoplites* (*Epihoplites*)  
Spath, 1925a

TYPE SPECIES: *Ammonites denarius* J. de C. Sowerby, 1826 (p. 78, pl. 511, fig. 1), from the lower Upper Albian of Blackdown, Devon, southern England, by the original designation of Spath (1925a, p. 81).

*Epihoplites* (*Epihoplites*) sp. juv.  
(Text-fig. 21)

MATERIAL: MWGUW ZI/63/0325, from Bed [-D] of the Koksyrtau-Aksyrtau section.

DESCRIPTION AND DISCUSSION: MWGUW ZI/63/0325 (Text-fig. 21) is a worn, phosphatised internal mould of a phragmocone 34.2 mm in diameter. Coiling is moderately evolute, the umbilicus shallow, with a low, outward inclined wall and broadly rounded umbilical shoulder. The whorl section is compressed, with feebly convex flanks, the outer flanks converging to broadly rounded ventrolateral shoulders and a flattened venter. Seven ribs per half



Text-fig. 20. Partial external suture of *Dimorphoplites* sp. juv., cf. *niobe* Spath, 1926a, MWGUW ZI/63/0134, from Bed G of the Shyrkala-Airakty section.



Text-fig. 21. *Epihoplites* (*Epihoplites*) sp. juv. MWGUW ZI/63/0325, from Bed D of the Koksyrtau-Aksyrtau section. Figures are  $\times 1$ .

whorl, arise at the umbilical seam, and strengthen across the umbilical wall, to form well-developed umbilical bullae. These give rise to groups of three ribs, with occasional ribs intercalating. The ribs are feebly prorsiradiate, strengthening across the flanks, sweeping forwards and feebly convex on the outer flanks, and linking to barely differentiated oblique ventrolateral bullae that are little more than strengthened rib ends that alternate in position on either side of the venter.

The ornament of this specimen, with ribs arising in groups of three from the umbilical bullae, suggests that its affinities are with *Epihoplites denarius* (J. de C. Sowerby, 1826) (p. 78, pl. 540, smaller specimen only; lectotype refigured by Spath 1926a, pl. 15, fig. 10, and Cooper and Owen 2011b, text-fig. 3c, d).

OCCURRENCE: As for material.

#### Genus *Callihoplites* Spath, 1925a

TYPE SPECIES: *Ammonites catillus* J. de C. Sowerby, 1827 (p. 123, pl. 564, fig. 2), by the original designation of Spath (1925a, p. 81).

*Callihoplites vraconensis vraconensis* (Pictet and Campiche, 1860)  
(Pl. 11, Figs 1–7)

1860. *Ammonites vraconensis* Pictet and Campiche, p. 231, pl. 31, fig. 1.

2014. *Callihoplites vraconensis vraconensis* (Pictet and Campiche, 1860); Klein, pp. 114, 121 (with full synonymy).

TYPE: The holotype, is no. 39878 in the collections of Musée géologique, Lausanne, the original of Pictet and Campiche (1860, pl. 31, fig. 1), from the Upper

Albian of Saint-Croix, Switzerland. It was refigured by Renz (1968, pl. 5, fig. 3).

MATERIAL: MWGUW ZI/63/1318, 1322, and 1324, from Bed 9 of the Besakty section. Two worn derived phosphatic fragments from Bed 9 of the Shakh-Bogota section may belong here.

DESCRIPTION: MWGUW ZI/63/1324 (Pl. 11, Figs 1–3) is the best-preserved specimen, a 90° whorl sector with a maximum preserved whorl height of 20 mm. The umbilicus is of moderate depth, the umbilical wall feebly convex and outward-inclined, the umbilical shoulder broadly rounded. The whorl section is compressed trapezoidal, with feebly convex inner flanks and flattened, convergent outer flanks, the ventrolateral shoulders broadly rounded, the venter feebly convex. There are four small umbilical bullae on the fragment. They give rise to pairs of ribs, with additional ribs intercalating, to give a total of 12 at the ventrolateral shoulder. The ribs arise in pairs from the bullae and intercalate. They are prorsiradiate, sinuous, convex on the innermost flanks, straight on the middle and outer flanks, flexing forwards and linking in pairs at strong ventrolateral clavi that alternate in position on either side of the venter, across which they are linked by a low, weak, broad swelling. MWGUW ZI/63/1318 (Pl. 11, Figs 6, 7) and 1322 (Pl. 11, Figs 4, 5) are poorly preserved limonite-encrusted individuals, the largest 51.5 mm in diameter, with traces of comparable ribbing and tuberculation.

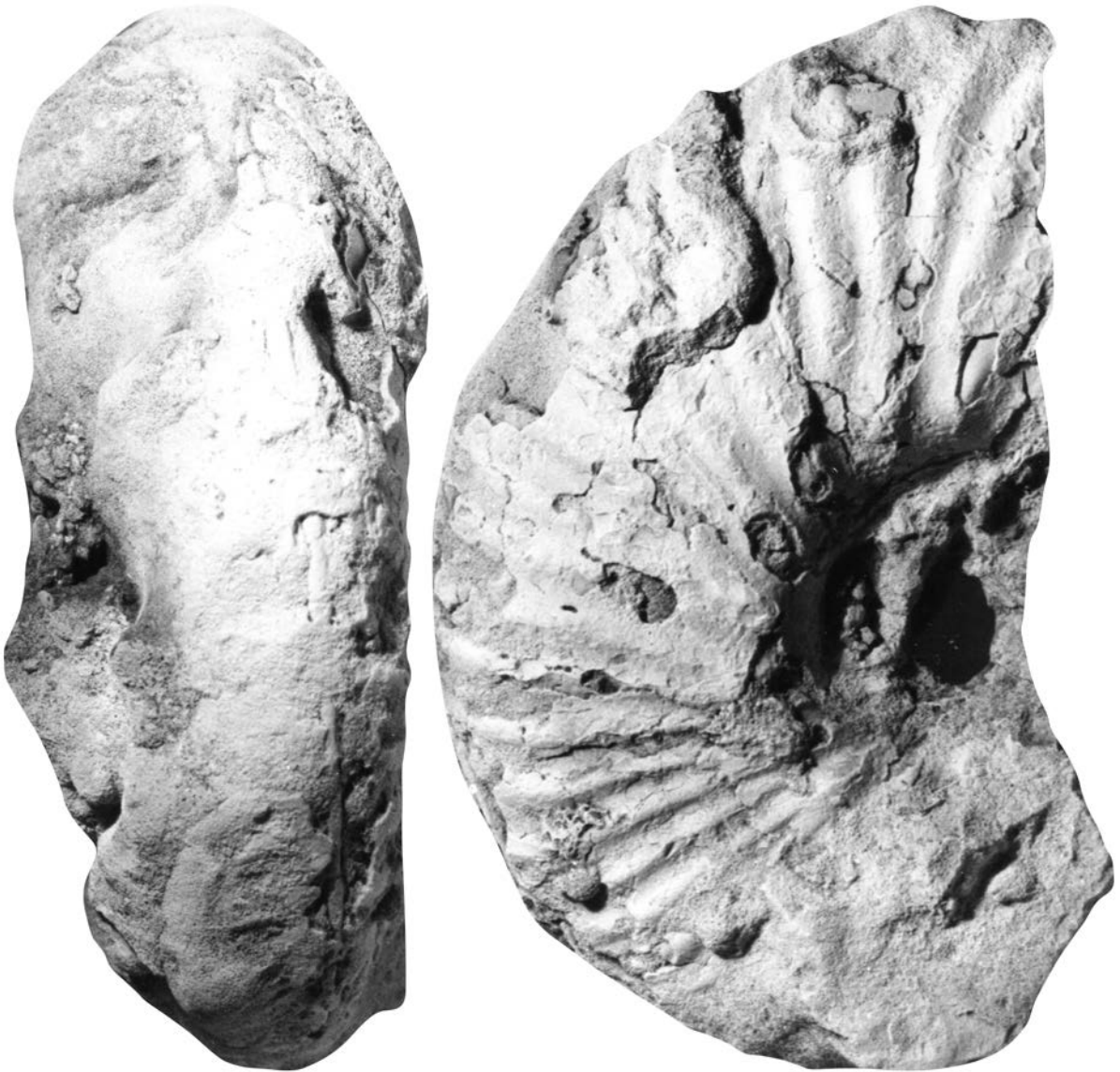
DISCUSSION: The ornament of MWGUW ZI/63/1324 (Pl. 11, Figs 1–3) differs in no significant respects from that of the holotype.

OCCURRENCE: Upper Upper Albian, Switzerland, southern England, France, ?Hungary, and the Mangyshlak Mountains of western Kazakhstan. The specimens from the Cenomanian part of the Shakh-Bogota sequence are interpreted as derived Upper Albian elements.

*Callihoplites* sp. A  
(Text-figs 22, 23)

MATERIAL: MWGUW ZI/63/0523 and 0524, from Bed A2 of the Sulu-Kapy section, Upper Upper Albian.

DESCRIPTION: The specimens are 180° sectors of body chamber 145 and 149 mm in diameter, retaining areas of shell material in the case of MWGUW



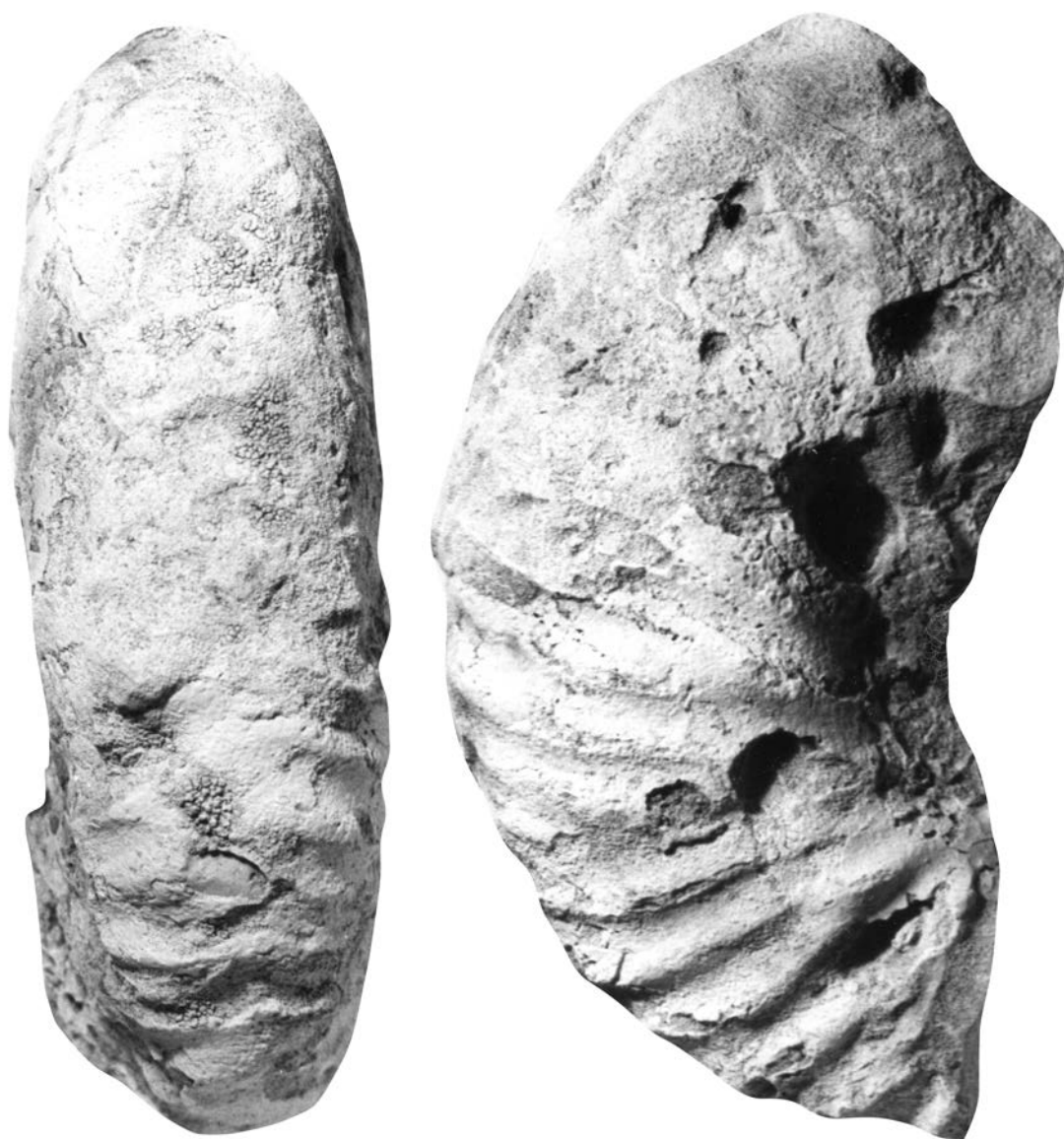
Text-fig. 22. *Callihoplites* sp. A, MWGUW ZI/63/0524, from Bed A of the Sulu-Kapy section. Figures are  $\times 1$ .

ZI/63/0524 (Text-fig. 22). The shallow umbilicus comprises approximately 25% of the diameter in this specimen, the wall feebly convex and outward-inclined, the umbilical shoulder broadly rounded. The whorl section is compressed (although the relative proportions cannot be accurately established), with feebly convex subparallel flanks, broadly rounded ventrolateral shoulders and a feebly convex venter. There are 11 weak umbilical bullae per half whorl in MWGUW ZI/63/0524 (Text-fig. 22). They give rise to pairs of ribs, and there are additional long and short intercalated ribs to produce a crowded flank or-

nement, the ribs straight and feebly prorsiradiate on the flanks, projecting forwards and feebly concave on the ventrolateral shoulder. Preservation of the venter is poor in this specimen. The venter of MWGUW ZI/63/0523 (Text-fig. 23) suggests the ribs alternate in position on either side of the venter, and possibly bear feeble oblique ventrolateral clavi.

DISCUSSION: Although body chambers, it is unclear if they are those of adults or juveniles. The ornament resembles that of the badly crushed holotype of *Callihoplites patella* Spath, 1927 (p. 192, pl. 20,





Text-fig. 23. *Callihoplites* sp. A, MWGUW ZI/63/0523, from Bed A of the Sulu-Kapy section. Figures are  $\times 1$ .

fig. 5; pl. 21, fig. 4) from the Upper Albian of Devizes in southern England, and this similarity is the basis for their assignment to *Callihoplites*.

OCCURRENCE: As for material.

Genus *Sulcohoplites* Michailova and Saveliev, 1994

TYPE SPECIES: *Sulcohoplites altifurcatus* Michailova and Saveliev, 1994 (p. 76, text-figs 1–5), by original designation.

*Sulcohoplites altifurcatus* Michailova and Saveliev, 1994  
(Pl. 12, Figs 1–7)

1994. *Sulcohoplites altifurcatus* Michailova and Saveliev, p. 76, text-figs 1–5.

2011c. *Sulcohoplites altifurcatus* Michailova and Savel'ev; Cooper and Owen, p. 334, text-fig. 1f, g, h.

2014. *Sulcohoplites altifurcatus* Michailova and Saveliev, 1994; Klein, p. 141.

TYPE: The holotype, by original designation, is

the original of Michailova and Saveliev (1994, text-figs 1, 2), no. 1563 in the collections of the All Russian Petroleum Scientific Research Geologic Prospecting Institute (VNIGRI), St. Petersburg, from the Albian *rossicus* Zone of the Tyubedzhik Nature Reserve, mouth of the Mansu-Almas ravine, on the Mangyshlak Peninsula, western Kazakhstan.

MATERIAL: MWGUW ZI/63/0575, 0576, 0582, 0584, 0587, 0591, from Bed J of the Sulu-Kapy section, lower Upper Albian, *rossicus* Zone.

#### DIMENSIONS:

	D	Wb	Wh	Wb:Wh	U
MWGUW ZI/63/0587	38.9 (100)	13.0 (33.4)	18.9 (48.6)	0.69	8.0 (20.6)

DESCRIPTION: Fragmentary internal moulds have whorl heights of up to 25.3 mm. MWGUW ZI/63/0587 (Pl. 12, Figs 3–5) is the best-preserved, a 180° whorl sector of phragmocone with a maximum preserved whorl height of 38.9 mm. Coiling is involute, the shallow umbilicus comprising 20.6% of the diameter, with a low, feebly convex, outward-inclined wall and broadly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.69, the flanks feebly convex, the outer flanks converging to narrowly rounded ventrolateral shoulders, the venter sulcate. Delicate wiry ribs, sixteen per half whorl, arise at the umbilical seam and strengthen across the umbilical wall. They are straight and prorsiradiate on the inner and middle flank, sweeping forwards and concave on the outer flank, and projected strongly forwards on the ventrolateral shoulder, where they reach their maximum strength, forming an obtuse chevron, interrupted by the ventral sulcus. They bifurcate below mid-flank, and additional ribs intercalate, to give a total of 36 at the ventrolateral shoulder.

DISCUSSION: The fragments show some variation in the strength of the ribbing, but their style compares well with that of the holotype, the only figured specimen of the type and only species assigned to *Sulcopholites*.

OCCURRENCE: Lower Upper Albian *rossicus* Zone of the Mangyshlak Mountains of western Kazakhstan.

Genus *Arrhaphoceras* Whitehouse, 1927

TYPE SPECIES: *Ammonites woodwardi* Seeley,

1865 (p. 236, pl. 11, fig. 3), by the original designation of Whitehouse (1927, p. 109).

*Arrhaphoceras substuderi* Spath, 1928  
(Pl. 11, Figs 8–15, 18, 19)

1928. *Arrhaphoceras substuderi* Spath, p. 254, pl. 24, fig. 19; text-fig. 84.

1996. *Arrhaphoceras substuderi* Spath; Marcinowski *et al.*, p. 37.

2014. *Arrhaphoceras substuderi* Spath, 1928; Klein, pp. 122, 125 (with full synonymy).

TYPE: The holotype, by original designation, is the original of Spath (1928, text-fig. 84c), no. B 1607 in the collections of the Sedgwick Museum, Cambridge. The paratype, the original of Spath's (1928) text-fig. 84b is no. B 1608b in the same collection. Both are from the phosphatised Upper Albian remanié fauna of the Cambridge Greensand of Cambridge in southern England.

MATERIAL: MWGUW ZI/63/1316, 1317, from Bed 9, and 1319 and 1484, from Beds 8–9 of the Besakty section.

DESCRIPTION: Specimens range from 37 mm to 51 mm in diameter and are coated with limonitised overgrowths; MWGUW ZI/63/1316 (Pl. 11, Figs 8–10), the smallest individual, is the best-preserved. The umbilicus is partially infilled with encrusting limonite, and the original proportions cannot be established. It was deep, with a convex, outward-inclined wall and broadly rounded umbilical shoulder, the whorl section depressed reniform. Low, broad ribs, five per half whorl, arise on the umbilical wall and strengthen into strong umbilical bullae that give rise to a single rib or a pair of coarse ribs, the adapical one feebly rursiradiate, the adapertural one prorsiradiate; additional long ribs intercalate, to give a total of 12 ribs per half whorl at the ventrolateral shoulder. The umbilical bullae alternate in position on either flank, and the ribs alternate in position on either side of the very obtusely fastigiate venter.

DISCUSSION: The material is slight and poorly preserved, but the ornament matches that of specimens referred to *substuderi* by both Spath (1928) and Renz (1968, pl. 2, figs 20–22), notably in the ventral development of the ribbing. Spath (1928) recognised several *Arrhaphoceras* species from the phosphatic remanié fauna of the Cambridge Greensand, as did Renz from the phosphatic faunas of La Vraconne in

Switzerland, and in the absence of significant numbers of contemporaneous individuals from expanded sequences, the limits of intraspecific variation in *substuderi* remain to be established.

Bed 9 of the Besakty section also yielded a crushed fragment of one flank of a much larger individual (MWGUW ZI/63/1315, Pl. 11, Figs 16, 17), perhaps as much as 70 mm in diameter, that preserves four massive umbilical bullae; it is left in open nomenclature.

OCCURRENCE: Upper Albian, Switzerland, Hungary, southern England, Bulgaria, and the Mangyshlak Mountains of western Kazakhstan.

*Arrhaphoceras* cf. *precoupei* Spath, 1928  
(Pl. 11, Fig. 20)

compare:

1928. *Arrhaphoceras precoupei* Spath, p. 252, pl. 21, fig. 1, pl. 22, fig. 6.

1996. *A.* cf. *precoupei* Spath; Marcinowski *et al.*, p. 37.

2014. *Arrhaphoceras precoupei* Spath, 1928; Klein, p. 123 (with synonymy).

TYPE: The holotype, by the original designation of Spath (1928, p. 252), is BGS GSM 37889, the original of Spath (1928, pl. 21, fig. 1), from the Upper Albian of Dorking in Surrey, southern England.

MATERIAL: MWGUW ZI/63/1355, from Bed 14 of the Besakty section.

DESCRIPTION: MWGUW ZI/63/1355 is an internal mould of a 90° whorl sector of body chamber with a maximum preserved whorl height of 51 mm approximately. The umbilical wall is feebly convex and outward-inclined, the umbilical shoulder very broadly rounded. The intercostal section is compressed trapezoidal, with feebly convex inner, and flattened mid- and outer flanks, the ventrolateral shoulders broadly rounded, the venter feebly convex to very obtusely fastigiate. Three widely separated ribs arise on the umbilical shoulder, and strengthen into strong umbilical bullae. These give rise to pairs of low ribs. The ribs link to strong, oblique prorsiradiate ventrolateral clavi that alternate in position on either side of the venter; there are five on the fragment. The relationship between ribs and ventrolateral clavi is irregular; they loop in pairs or link to successive clavi, one of which appears to be linked to a short intercalated rib. The ventrolateral clavi give rise to a low, broad rib that expands and effaces towards the mid-line of the venter.

DISCUSSION: Slight as the material is, the distinctive relationship between tubercles and ribs corresponds to that shown by the holotype of *precoupei* (Spath 1928, pl. 21, fig. 1a).

OCCURRENCE: As for material. The species is recorded from the upper Upper Albian of southern England, Switzerland, and Hungary.

Family Placenticeratidae Hyatt, 1900  
Genus *Placenticeras* Meek, 1876

TYPE SPECIES: *Ammonites placenta* DeKay, 1828 (p. 278), by the original designation of Meek (1876, p. 462).

*Placenticeras kolbajense* (Sokolov, 1967)  
(Pl. 12, Figs 17–19, 22–27)

1967. *Karamaiceras kolbajense* Sokolov, p. 138, text-figs a–d.

1967. *Karamaiceras kolbajense* Sokolov; Mirzoyev, p. 66, text-fig. 2c.

1983. *Karamaiceras kolbajense* Sokolov; Kennedy in Juignet *et al.*, p. 200, pl. 1, figs 13–15; text-fig. 7.

2008. *Placenticeras kolbabajense* (sic) (Sokolov, 1967); Kennedy in Kennedy *et al.*, p. 126, pl. 2, figs 1–17; pl. 3, figs 1–14; pl. 5, figs 4–6; pl. 8, figs 17, 18; text-figs 5, 6.

TYPE: The holotype, by original designation, is the original of Sokolov (1967, text-figs a, b), from the Upper Albian of Kolbay. Kennedy *et al.* (2008, p. 126) concluded it to be from fossil horizon 2 of their section, which they referred to the Upper Albian *perinflata* Zone.

MATERIAL: There are specimens from Bed 9 of the Besakty section: MWGUW ZI/63/1312, 1329, 1331, 1357, and 1483.

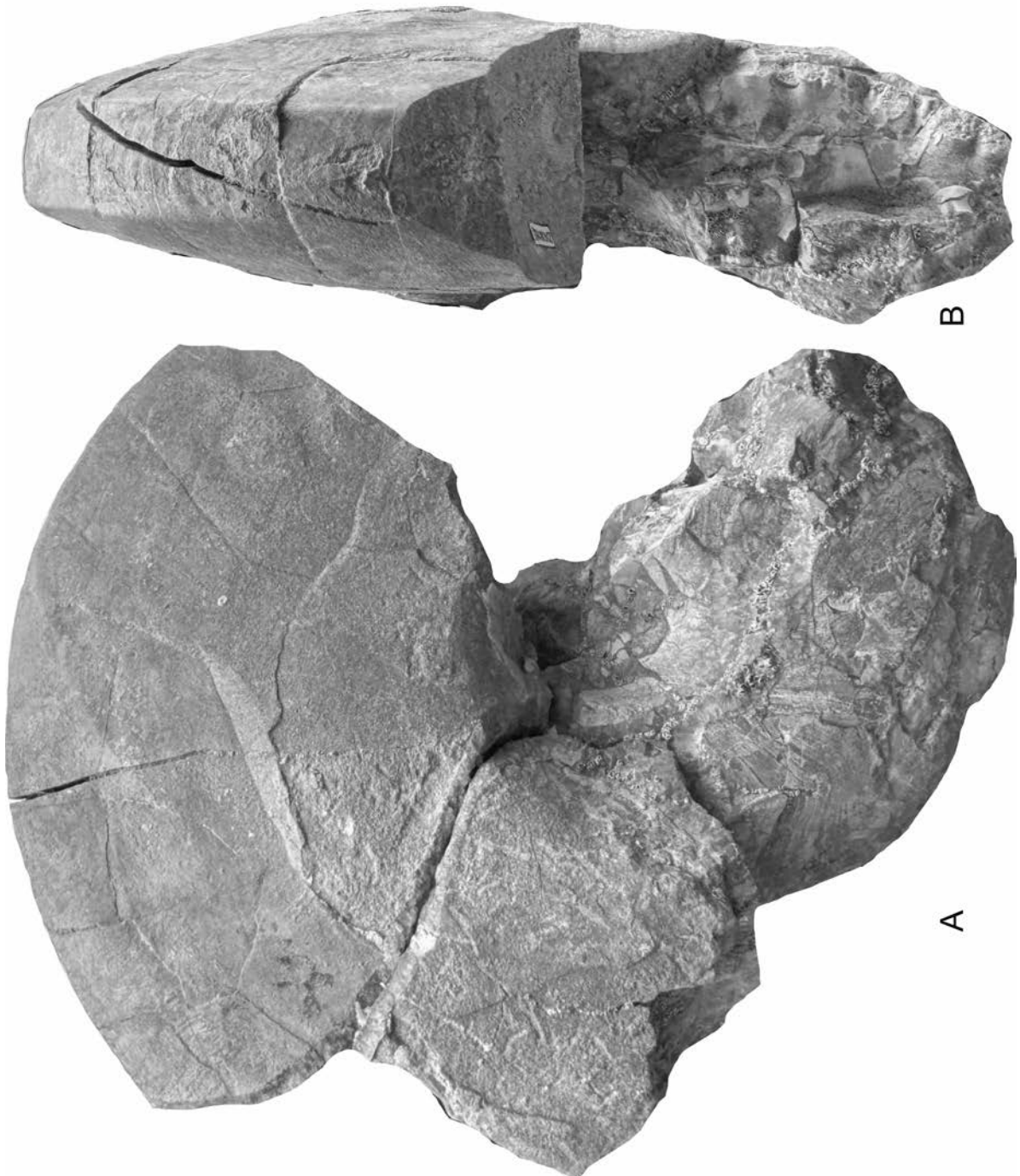
DISCUSSION: The Besakty material consists of nuclei that range from 32 mm in diameter to the largest individual, a 180° sector of body chamber 100 mm in diameter (Pl. 12, Fig. 22). Preservation is poor, with many specimens bearing limonitic overgrowths that obscure the ornament. They show, however, the same ontogenetic sequence as the much better topotype material from Kolbay figured and described by Kennedy in Kennedy *et al.* (2008): initially near-smooth (Pl. 12, Figs 18, 26), or with traces of falcooid growth lines and striae, the ventrolateral shoulders sharp and entire,



then with distant falcoid ribs (Pl. 12, Fig. 24) which in some specimens link to delicate clavi on the angular ventrolateral shoulder (MWGUW ZI/63/1357), and finally a body chamber that develops widely separated umbilicolateral bullae, the ventrolateral clavi eventually lost, the venter rounding, as in MWGUW ZI/63/1483 (Pl. 12, Fig. 22), which corresponds to the

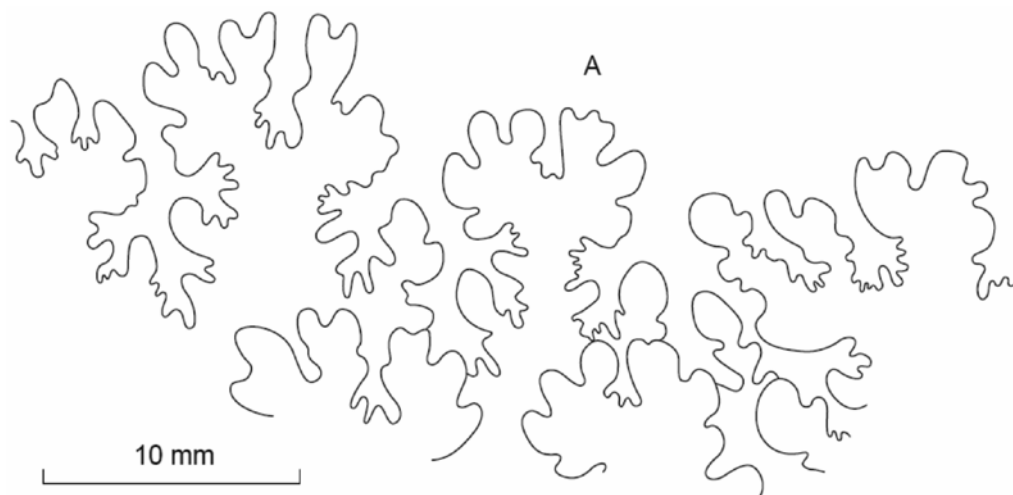
much better preserved adult from Kolbay (Kennedy *et al.* 2008, pl. 3, figs 12–14).

OCCURRENCE: Upper Upper Albian, *perinflata* Zone and correlatives, Kolbay and Besakty in the Mangyshlak Mountains of western Kazakhstan, and Sarthe, France.



Text-fig. 24. *Placenticerus* sp. MWGUW ZI/63/0185, from Beds 14–16 of the Besakty section. Figures are  $\times 1$ .





Text-fig. 25. *Placenticerus* sp. Partial external suture of MWGUW ZI/63/1310, from Bed 14 of the Besakty section.

*Placenticerus* sp.  
(Text-figs 24, 25)

MATERIAL: MWGUW ZI/63/1309, 1310 from Bed 14, and MWGUW ZI/63/0185 from Beds 14–16 of the Besakty section.

DESCRIPTION: These specimens are internal moulds with traces of original aragonitic shell, preserved in septarian concretions. The largest, MWGUW ZI/63/0185 is an adult 160 mm in diameter. Coiling is involute, the umbilicus small and deep, with a flattened, outward inclined wall and narrowly rounded umbilical shoulder. The whorl section is compressed, with a whorl breadth to height ratio of 0.55–0.6, the greatest breadth close to the umbilical shoulder, the very feebly convex flanks converging to very narrowly rounded ventrolateral shoulders and a flattened, barely convex venter. At the adapical end of the outer whorl of MWGUW ZI/63/0185, the ventrolateral shoulders bear minute oblique clavi. Where replaced shell and internal mould are well-preserved, their surface is ornamented by delicate lirae that increase by branching and intercalation (Text-fig. 24). They are straight and prorsiradiate on the inner flanks, convex at mid-flank, and concave on the outer flank, sweeping forwards to the ventrolateral shoulder, which lacks clavi on body chambers. Body chambers develop small, strongly prorsiradiate umbilical bullae, and there are traces of low, widely separated, barely detectable ribs that parallel the lirae.

OCCURRENCE: As for material.

Superfamily Acanthoceratoidea de Grossouvre, 1894  
Family Brancoceratidae Spath, 1934  
Subfamily Brancoceratinae Spath, 1934  
Genus *Hysterocheras* Hyatt, 1900

TYPE SPECIES: *Ammonites varicosus* J. de C. Sowerby, 1824 (p. 74, pl. 451, fig. 1), by the original designation of Hyatt (1900, p. 590).

*Hysterocheras binum* (J. Sowerby, 1815)  
(Pl. 13, Figs 3–6, 10–12)

1815. *Ammonites binus* J. Sowerby, p. 208, pl. 92, fig. 3.  
1934. *Hysterocheras subbinum* Spath, p. 481, pl. 52, figs 5–7; pl. 53, figs 6, 7; pl. 56, figs 3, 4.  
2018. *Hysterocheras binum* (J. Sowerby, 1815); Klein, pp. 30, 34 (with synonymy).  
2018. *Hysterocheras subbinum* Spath, 1934; Klein, pp. 30, 45 (with synonymy).

TYPE: The holotype, by monotypy, is BMNH 43956, the original of J. Sowerby (1815, p. 208, pl. 92, fig. 3), from Pleistocene deposits at Bramerton, Norfolk, eastern England. It was refigured by Spath (1934, text-fig. 165a, b), and is illustrated here as Pl. 13, Figs 11, 12.

MATERIAL: MWGUW ZI/63/0557, 0560–0562, 0563 (two fragments), 0564, 0566, 0568, and 0569, from Bed A1 of the Sulu-Kapy section.

DESCRIPTION: The complete individuals in the present assemblage vary from 19.5 to 35 mm in diameter. The best preserved of these is MWGUW ZI/63/0566

(Pl. 13, Figs 3, 4), 32.5 mm in diameter. Coiling is evolute, the shallow umbilicus comprising 30% of the diameter, the umbilical wall low, feebly convex, and outward-inclined, the umbilical shoulder broadly rounded. The whorl section is compressed, with flattened flanks, broadly rounded ventrolateral shoulders and a feebly convex venter with a well-developed siphonal keel. An estimated nine small bullae perch on the umbilical shoulder, and give rise to pairs of ribs; there are 15–16 per half whorl at the ventrolateral shoulder. The ribs are initially narrow, the adapical of each pair rursiradiate, the adapertural prorsiradiate. All then flex back, broaden progressively and are feebly concave, reaching their maximum strength on the ventrolateral shoulders and venter, where they form an obtuse chevron with the siphonal keel at the apex.

DISCUSSION: The present specimens are referred to *Hysteroceeras binum* on the basis of the compressed whorl section, ribs arising in pairs from small umbilical bullae, and the well-developed siphonal keel. *Hysteroceeras subbinum* Spath, 1934 (p. 481, pl. 52, figs 5–7; pl. 53, figs 6, 7; pl. 56, figs 3, 4) is a synonym. Spath (1934, p. 481) distinguished *subbinum* from *binum* on the slightest of grounds: “This very common form might have been considered to be merely a variation of the coarse *H. binum* in the direction of the finely ribbed *H. carinatum*, but since there are already several varieties in each species, as now established, it seems preferable to keep them apart specifically.”

OCCURRENCE: Upper Albian, *pricei*, *inflatum* and *fallax* zones, southern England, France, Spain, Sardinia, Germany, Poland, Hungary, Bulgaria, Georgia, the Mangyshlak Mountains of western Kazakhstan, Turkmenistan, Nigeria, Angola, KwaZulu-Natal in South African, Madagascar, Japan and, possibly, Venezuela.

*Hysteroceeras orbigny* (Spath, 1922)  
(Pl. 13, Figs 1, 2, 7–9)

1841. *Ammonites varicosus* d’Orbigny, p. 294 (*pars*), pl. 87, figs 1–3, non 4.

1922. *Brancoceras orbigny* Spath, p. 99.

2018. *Hysteroceeras orbigny orbigny* (Spath, 1922); Klein, pp. 31, 40 (with synonymy).

TYPE: The holotype, by monotypy is MNHN F. R04276, no. 5756 in the d’Orbigny collection, the original of d’Orbigny [1841, p. 294 (*pars*), pl. 87, fig. 3 only], from Perte du Rhône, in the commune of Bellegarde-sur-Valserine, Ain, France.

MATERIAL: MWGUW ZI/63/0565, from Bed A of the Sulu-Kapy section.

DESCRIPTION: The specimen is a 180° sector of body chamber with a maximum preserved diameter of 35 mm. Coiling is evolute, the umbilicus comprising 36% approximately of the diameter, of moderate depth, with a flattened, outward-inclined wall and a broadly rounded umbilical shoulder. The intercostal whorl section is compressed, with flattened subparallel flanks, broadly rounded ventrolateral shoulders, and a feebly convex venter. Seven small bullae perch on the umbilical shoulder of the fragment and give rise to single prorsiradiate ribs that strengthen progressively across the flanks, as do single intercalated ribs that arise below mid-flank, to give a total of 12 at the ventrolateral shoulder. The ribs sweep forwards and reach their maximum strength on the ventrolateral shoulders and venter, where they are blunt, coarse, and form an obtuse ventral chevron. There is a delicate siphonal ridge, visible only under oblique light.

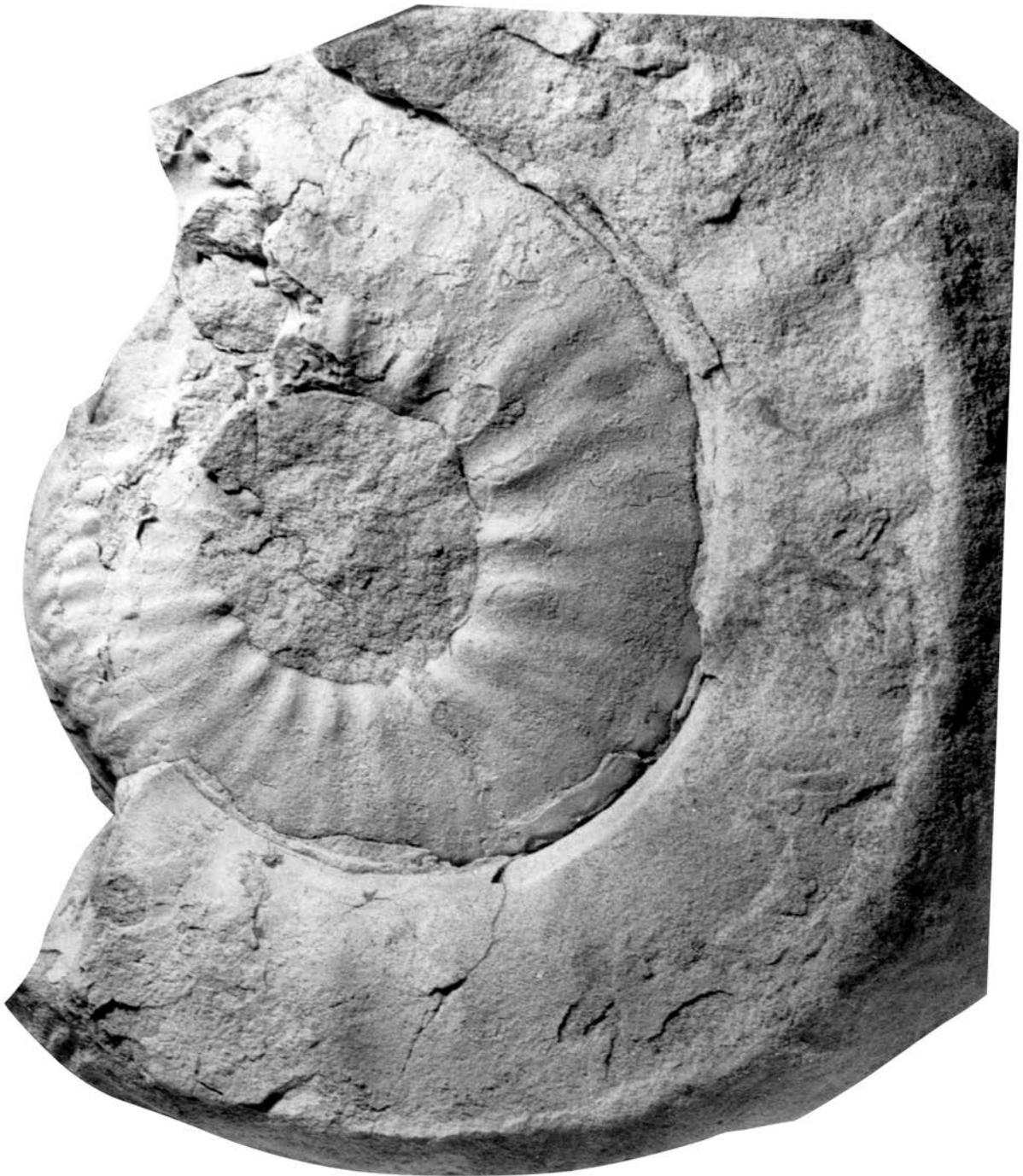
DISCUSSION: The ribs at the adapical end of the fragment correspond to those at the adapertural end of the outer whorl of the holotype at approximately the same whorl height; those on the remainder of the fragment are straighter across the flanks before flexing forwards on the ventrolateral shoulders, as in the larger of d’Orbigny’s specimens (1841, pl. 87, figs 1, 2; Pl. 13, Figs 7–9 herein). The coarser ribbing and absence of a strong siphonal keel separate the specimen from co-occurring *Hysteroceeras binum*.

OCCURRENCE: The species occurs in the *cristatum* and *pricei* zones, with records from southern and eastern England, France, Spain, Switzerland, Austria, Poland, Slovakia, Romania, Ukraine, Georgia, the Mangyshlak Mountains of western Kazakhstan, north-east Iran, Angola, KwaZulu-Natal in South Africa, Mozambique, Madagascar, Texas and Venezuela.

Subfamily Pervinquieriinae Spath, 1926b  
Genus and subgenus *Pervinquieria* Böhm, 1910

TYPE SPECIES: *Ammonites inflatus* J. Sowerby, 1818 (p. 170, pl. 178), by the original designation of Böhm (1910, p. 152).

*Pervinquieria* (*Pervinquieria*) *pricei*  
(Spath, 1922)  
(Text-fig. 26)



Text-fig. 26. *Pervinquieria (Pervinquieria) pricei* (Spath, 1922), from Bed A of the Sulu-Kapy section. The figure is  $\times 1$ .

1922. *Subschloenbachia pricei* Spath, p. 101.

1932. *Mortoniceras (Pervinquieria) pricei* (Spath); Spath, p. 391, pl. 35, figs 11, 12; pl. 37, fig. 3; pl. 38, fig. 5; text-figs 130c, 131, 132, 137c.

2018. *Mortoniceras (Mortoniceras) pricei pricei* (Spath, 1922); Klein, pp. 101, 120 (with synonymy).

2018. *Mortoniceras (Mortoniceras) pricei intermedium* (Spath, 1932); Klein, pp. 101, 120 (with synonymy).

2020. *Pervinquieria (Pervinquieria) pricei* (Spath, 1922); Kennedy in Gale and Kennedy, p. 41, pl. 18, fig. 3.

TYPE: The holotype, by monotypy is BMNH C12488,



the original of Spath (1932, text-fig. 131), from the Upper Albian Gault Clay of Folkestone in southern England.

**MATERIAL:** MWGUW ZI/63/0288, from Bed A of the Sulu-Kapy section.

**DESCRIPTION:** The specimen consists of a phragmocone retaining worn, recrystallized shell an estimated 120 mm in diameter, and the umbilical wall and inner flank of the adapical 240° sector of the succeeding whorl. The umbilicus comprises approximately 33% of the diameter, and is shallow, with a low, slightly concave umbilical wall and a broadly rounded umbilical shoulder. The intercostal whorl breadth to height ratio is 0.68 approximately. Twenty five ribs arise on the umbilical wall of the phragmocone, and strengthen into well-developed umbilical bullae. These give rise to single ribs or a pair of ribs, and additional ribs intercalate on the inner flanks. The ribs are low, straight, and broaden across the flanks, strengthen on the ventrolateral shoulders and develop into an incipient prorsiradate bulla, the bullae separated from the strong siphonal keel by a smooth zone.

**DISCUSSION:** The adapertural part on the antepenultimate whorl and the adapical part of the penultimate whorl correspond to the holotype in both size and ornament. See discussion in Kennedy *et al.* (1999, p. 1109).

**OCCURRENCE:** Lower Upper Albian, index of the *pricei* Zone, with records from southern England, France, Poland, Ukraine (Crimea), the Mangyshlak Mountains of western Kazakhstan, Morocco, Algeria, Nigeria, KwaZulu-Natal in South Africa, Madagascar, Texas, and Venezuela.

#### Subgenus *Deiradoceras* van Hoepen, 1931

**TYPE SPECIES:** *Inflatoceras prerostrata* Spath, 1921 (p. 284, pl. 24, fig. 10), by the original designation of van Hoepen (1931, p. 52).

*Pervinquieria* (*Deiradoceras*) sp.  
(Pl. 13, Fig. 13)

**MATERIAL:** MWGUW ZI/63/0508 and 0554, from Bed A of the Sulu-Kapy section.

**DESCRIPTION:** MWGUW ZI/63/0508 (Pl. 13, Fig. 13) is one flank and part of the venter of a 90° whorl

sector retaining recrystallized shell; the maximum preserved whorl height is 25 mm. There are three strong umbilical bullae on the fragment that give rise to single ribs, with single ribs intercalating below mid-flank and sometimes tenuously linked to the bullae. The ribs are coarse, blunt and prorsiradate, and link to conical ventrolateral tubercles, from which a broad wedge-shaped rib projects strongly forwards, declines and effaces. There is a strong siphonal keel. MWGUW ZI/63/0554 is a 60° whorl fragment with a maximum preserved whorl height of 35 mm with comparable, but more subdued ornament.

**DISCUSSION:** These fragments are assigned to *Deiradoceras* on the basis of the presence of umbilical and a single row of ventrolateral tubercles only. They are specifically indeterminate.

**OCCURRENCE:** As for material.

#### Genus *Goodhallites* Spath, 1932

**TYPE SPECIES:** *Ammonites Goodhalli* J. Sowerby 1820 (p. 100, pl. 355), by the original designation of Spath (1932, p. 381).

*Goodhallites goodhalli* (J. Sowerby, 1820)  
(Pl. 13, Figs 20–22)

1820. *Ammonites Goodhalli* J. Sowerby, p. 100, pl. 255.

2018. *Goodhallites goodhalli* (J. Sowerby, 1820); Klein, pp. 148, 150 (with synonymy).

**TYPE:** The holotype is BMNH 43949a, the original of J. Sowerby (1820, p. 100, pl. 255), from the Upper Albian Blackdown Greensand of Blackdown, Devon, in southern England.

**MATERIAL:** MWGUW ZI/63/0553, 0555, 0559, and 0564, from Bed A of the Sulu-Kapy section.

**DESCRIPTION:** MWGUW ZI/63/0553 (Pl. 13, Figs 20–22) is the largest and most complete specimen; the others are small whorl fragments). Coiling is moderately involute, the shallow umbilicus comprising 25% approximately of the diameter. At a diameter of 77 mm, a relatively well-preserved half whorl retains extensive areas of recrystallized shell. The whorl section is compressed, with a whorl breadth to height ratio of 0.6 approximately, the flanks very feebly convex and subparallel, the ventrolateral shoulders broadly rounded, the venter very feebly convex,

with a strong siphonal keel. Ten ribs arise on the umbilical wall of the half whorl and strengthen into small bullae, perched on the umbilical shoulder. They give to single ribs or pairs of ribs, and additional ribs intercalate to give a total of 26 ribs at the ventrolateral shoulder of the half whorl. The ribs are straight and prorsiradiate on the inner flank, flexing back and concave on the outer flank and sweeping forwards across the ventrolateral shoulder, strengthening slightly into incipient bullae before sweeping forwards, declining, and forming an obtuse ventral chevron with the siphonal keel at the apex.

DISCUSSION: Whorl section, crowded falcoid ribs with small umbilical bullae and incipient ventrolateral bullae show this specimen to be a *Goodhallites*, close to the holotype of *goodhalli* (refigured by Spath 1934, text-fig. 154) and variants such as *Goodhallites goodhalli aplanata* Spath, 1934 (pl. 51, fig. 6).

OCCURRENCE: *Pervinquieria pricei* Zone, southern England, France, Spain, Bulgaria, the Mangyshlak Mountains of western Kazakhstan, northern Iran, Angola, KwaZulu-Natal in South Africa, Madagascar, Queensland in Australia, and Venezuela.

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 the original designation of Spath (1925c, p. 189).

*Idiohamites* sp.  
 (Pl. 12, Figs 20, 21)

MATERIAL: MWGUW ZI/63/0567, from Bed A of the Sulu-Kapy section.

DESCRIPTION AND DISCUSSION: A 26 mm long slightly curved fragment has a maximum preserved whorl height of 9.3 mm and a whorl breadth to height ratio of 0.7, the whorl section oval. The rib index is six. The ribs are weak, straight and transverse on the dorsum, strengthen across the dorsolateral margin and flanks, where they are straight and prorsiradiate. Preservation of the venter is poor, but most ribs appear to bear a small ventral tubercle, the ribs linked across the venter by a transverse rib. The fragment is specifically indeterminate.

OCCURRENCE: As for material.

Family Hamitidae Gill, 1871  
 Genus *Hamites* Parkinson, 1811

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

*Hamites incurvatus* Brown, 1837  
 (Pl. 13, Figs 14–19)

1811. *Hamites* sp. Parkinson, p. 143, pl. 10, fig. 2.  
 1837. *Hamites incurvatus* Brown, p. 3, pl. 1, fig. 4.  
 2015. *Hamites (Hamites) incurvatus* Brown, 1837; Klein, pp. 43, 86 (with synonymy).

TYPE: The holotype is BMNH C.79390 (ex 43992e), the original of Parkinson (1811, pl. 10, fig. 2) and Brown (1837, pl. 1, fig. 4). The provenance is unknown. It was refigured by Spath (1941, text-fig. 223a, b).

MATERIAL: MWGUW ZI/63/1240, from Bed D of the Koksyrtau-Aksyrtau section, lower Upper Albian. MWGUW ZI/63/1260, from Bed 1 of the Shakh-Bogota section, lower Upper Albian, *Michaliskii* Zone.

DESCRIPTION: MWGUW ZI/63/1240 (Pl. 13, Figs 17–19) is an internal mould of a straight shaft 56 mm long, from the adapical end of a body chamber, the adapical end a septal face. The maximum preserved whorl height is 17 mm; one flank is worn, so that the whorl breadth to height ratio can only be estimated at around 0.9, the whorl section compressed oval. The rib index is six. The ribs are well-developed and feebly concave on the dorsum, strengthen across the dorsolateral margin, are straight and prorsiradiate across the flanks, and straight and transverse on the venter.

MWGUW ZI/63/1260 (Pl. 13, Figs 14–16) is a well-preserved fragment of an internal mould of a slightly curved body chamber fragment 44.5 mm long, with a maximum preserved whorl height of 19 mm, the whorl breadth to height ratio 0.76. Ornament is as in the previous specimen, with a rib index of six.

DISCUSSION: These fragments are referred to *incurvatus* on the basis of whorl section, rib style and density. In addition to these large fragments, there is a tiny fragments of *Hamites* (MWGUW ZI/63/0126) with a maximum preserved whorl section of 6.5 mm from Bed 2 of the Shyrkala-Airakty section.

OCCURRENCE: Lower Upper Albian where well-dated. There are records from southern England, Hautes-Alpes in France, Poland, the Mangyshlak Mountains of western Kazakhstan, and, possibly, Central Iran.

SYSTEMATIC PALAEOLOGY:  
INOCERAMIDS (I. Walaszczyk)

All specimens are housed in the Stanisław Józef Thugutt Museum of the Faculty of Geology of the University of Warsaw (MWGUW ZI/63).

Order Pterioidea Newell, 1965  
Family Inoceramidae Giebel, 1852  
Genus *Gnesioceramus* Heinz, 1932

TYPE SPECIES: *Inoceramus anglicus* Woods, 1911 (p. 264, pl. 45, figs 8–10, text-fig. 29), by the subsequent designation of Pokhialainen (1985b, p. 32). For further discussion see Walaszczyk and Cobban (2016).

*Gnesioceramus anglicus* (Woods, 1911)  
(Text-fig. 27)

1910. *Inoceramus anglicus* sp. nov.; Woods, p. 264, text-fig. 20; pl. 45, figs 8–10.  
1962. *Inoceramus anglicus* Woods; Saveliev, p. 222; pls 1–3.  
1962. *Inoceramus anglicus* Woods forma *rhomboidalis* Saveliev forma n., Saveliev, p. 224, pl. 3, figs 1–3.

TYPE: The lectotype, designated by Saveliev (1962, p. 223), is the original of Woods (1911, pl. 45, figs 8a, b), from the Upper Albian Hunstanton Formation of Hunstanton, England.

MATERIAL: MWGUW ZI/63/1788, 1791, 1796–1799 from Bed [-D] of the Koksyrtau-Aksyrtau section; MWGUW ZI/63/0669 from Bed G, MWGUW ZI/63/1284 from Bed E, and MWGUW ZI/63/1790 from Bed 1B of the Shyrkala-Airakty section; MWGUW ZI/63/1785–1787 from Beds 1 and 2, and MWGUW ZI/63/1789 from Bed 2, of the Shakh-Bogota section. All specimens are from the zones of *A. rossicus* and/or *S. michalskii*. A single specimen, MWGUW ZI/63/0613b is from Bed J of the Sulu-Kapy section, lower Middle Albian, *A. intermedius* Zone.

DESCRIPTION AND REMARKS: Valves are sub-

triangular to trapezoidal in outline, equivalve, inequilateral, weakly inflated. The disc is triangular in outline; it passes into a poorly differentiated posterior auricle. The umbo is pointed, only slightly projecting above the hinge line. The hinge line is straight. and of moderate length, and straight. The shelly material is not preserved in the material studied; most of the specimens had a well-developed oblique interior rib on the posterior part of the posterior auricle. The ligament is not preserved, however, it must have been massive, as suggested by the internal moulds. The ornamentation consists of strong, regular concentric rugae, changing from symmetrical in juvenile parts to slightly asymmetrical in the adults.

OCCURRENCE: Saveliev (1962) reports the species from the interval spanning the upper Lower through top of the Upper Albian of Mangyshlak in western Kazakhstan.

Genus *Actinoceramus* Meek, 1864

TYPE SPECIES: *Inoceramus sulcatus* Parkinson, 1819 (pl. 1, fig. 5); by monotypy.

REMARKS: The interpretation of the taxonomy and evolution of the genus used here follows Crampton (1996; and subsequently Crampton and Gale 2005, 2009), and the reader is referred to these original papers for complete discussion and details. The descriptions and discussions provided here are limited to the Mangyshlak material and refer mostly to Saveliev's (1962) interpretations of the Albian inoceramids from the area.

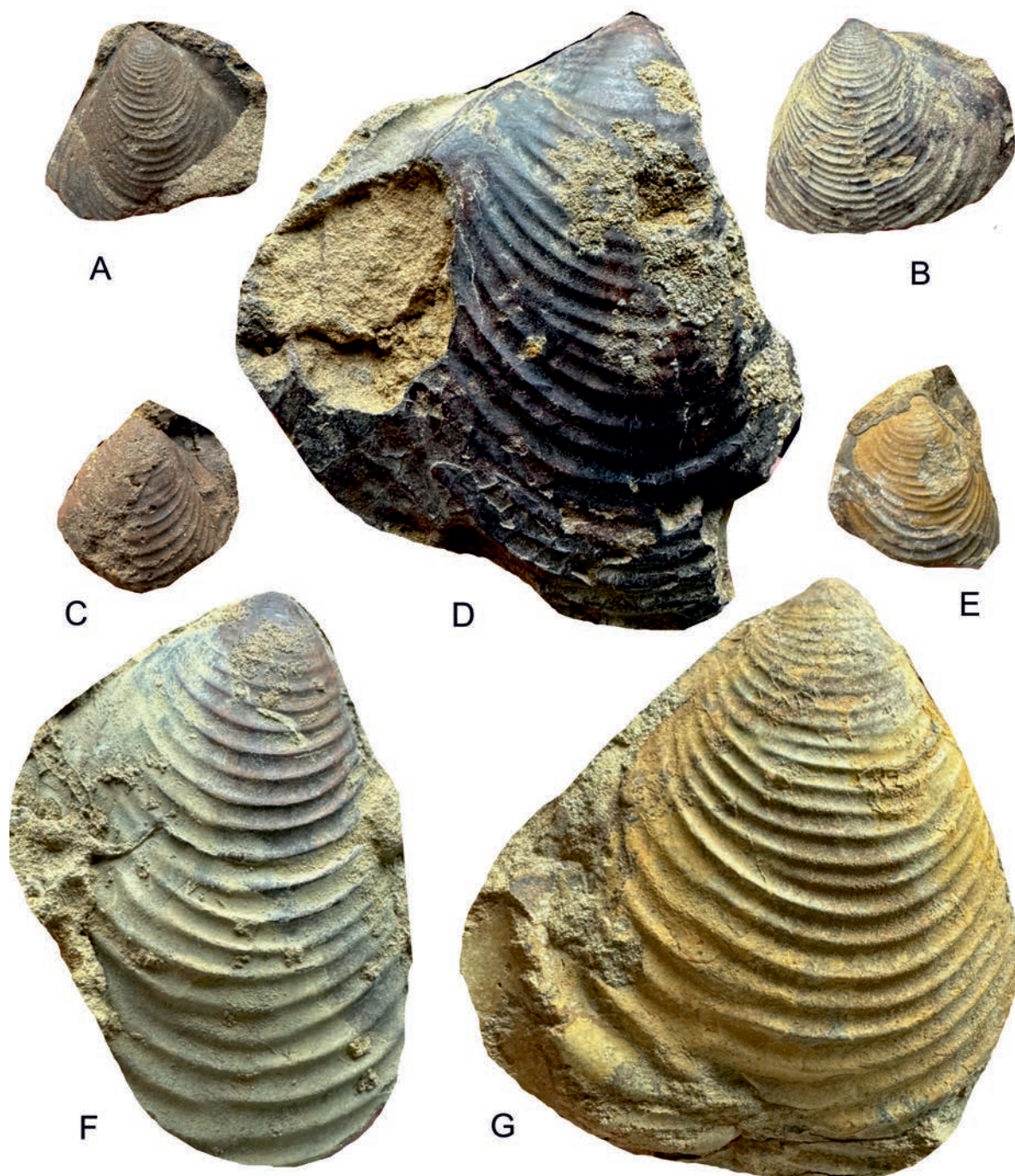
*Actinoceramus salomoni salomoni* (d'Orbigny, 1850)  
(Text-fig. 28I, L)

1962. *Inoceramus salomoni* Orbigny; Saveliev, p. 238, pl. 9, figs 6–9; pl. 10, figs 1–4.  
1962. *Inoceramus salomoni* Orb. morpha *caveata* Savel. morpha n.; Saveliev, p. 241, pl. 9, figs 7, 9; pl. 10, figs 2–5.  
1962. *Inoceramus salomoni* Orb. morpha *incaveata* Savel. morpha n.; Saveliev, p. 241, pl. 9, fig. 8; pl. 10, fig. 1.

TYPE: The original specimen of d'Orbigny (1850) has not been traced (see discussion in Crampton 1996).

MATERIAL: Three specimens from Bed O of the





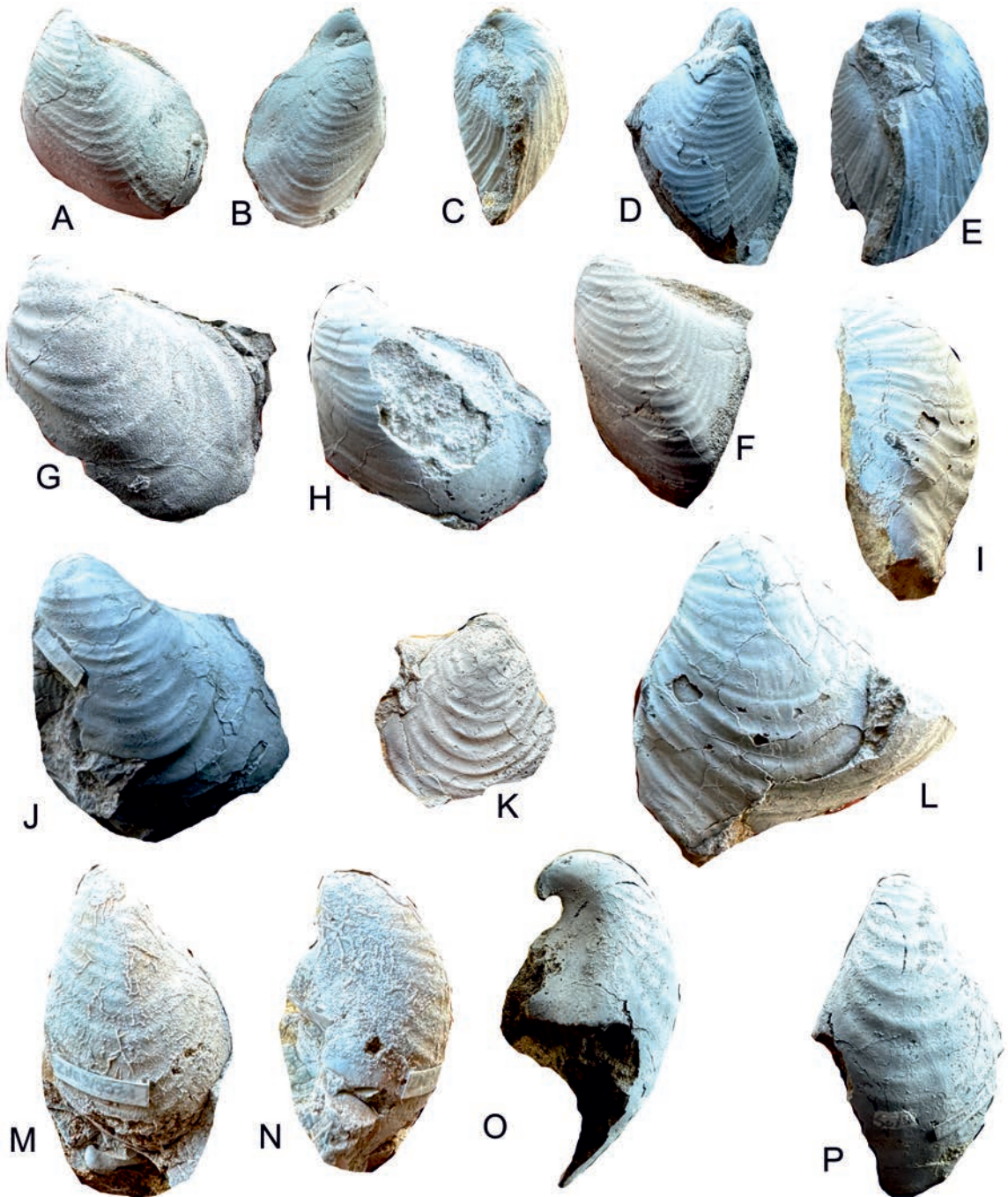
Text-fig. 27. *Gnesioceramus anglicus* (Woods, 1911). A – MWGUW ZI/63/1785; B – MWGUW ZI/63/1786; C – MWGUW ZI/63/1787; D – MWGUW ZI/63/1788; E – MWGUW ZI/63/1789; F – MWGUW ZI/63/1790; G – MWGUW ZI/63/1791. A–C, E are from the Shakh-Bogota section, *S. michalskii* Zone; D and G are from the Koksyrtau-Aksyrtau section Bed [-D], *A. rossicus* Zone; F is from Bed 1A of the Shyrkala-Airakty section. All figures are  $\times 1$ .

Shyrkala-Airakty section; MWGUW ZI/63/0146, 0148, and 0338.

DESCRIPTION AND REMARKS: The material

consists of three incomplete left valves, with characteristically rhomboidal outline, and two with developed anterior radial sulcus. The umbonal part is missing in both valves.





Text-fig. 28. A–F – *Actinoceramus sulcatus biometricus* Crampton, 1996; A–C – MWGUW ZI/63/0662; D–F – MWGUW ZI/63/0657; both from Bed A of the Sulu-Kapy section. G, H, J, K – *Actinoceramus concentricus expandoclunis* Crampton, 1996; G, K – MWGUW ZI/63/0650 (K – right valve); H – MWGUW ZI/63/0155; J – MWGUW ZI/63/0176; all specimens from Bed O of the Shyrkala-Airakty section. I, L – *Actinoceramus salomoni salomoni* (d’Orbigny, 1850); MWGUW ZI/63/0148, from Bed O of the Shyrkala-Airakty section. M–P – *Actinoceramus concentricus concentricus* (Parkinson, 1819); M, N – MWGUW ZI/63/0634; O, P – MWGUW ZI/63/0614; both from Bed J of the Sulu-Kapy section. All figures are  $\times 1$ .

OCCURRENCE: All specimens come from Bed O of the Shyrkala-Airakty section, which clearly spans the top of the Lower and basal Middle Albian.

*Actinoceramus concentricus expandoclunis*  
Crampton, 1996  
(Text-fig. 28G, H, J, K)

1996. *Actinoceramus concentricus expandochunis* subsp. nov., Crampton, p. 38, pl. 2A–F.

TYPE: The holotype, by original designation, is OUMNH PAL.-K.30916/3, the original to Crampton (1996, pl. 2, figs A, C, D), from the Gault at Black Head, Osmington, Dorset, England. The paratypes are OUMNH PAL.-K30916/2 and 10, both from the type locality.

MATERIAL: Seven specimens from Bed O of the Shyrkala-Airakty section; MWGUW ZI/63/0152, 0155, 0166, 0176, 0648 (transitional form between *A. c. expandochunis* and *A. c. concentricus*), and 0650a, b.

DESCRIPTION AND REMARKS: With the exception of one individual, all specimens are internal moulds of left valves; single right valve may be paired with the LV. All left valves have an elliptical outline, with long rounded antero-ventral margin, and are extended postero-ventrally. Growth axis is distinctly curved, convex towards the antero-ventral margin. The umbo of the left valve is long, projecting distinctly over the hinge line, incurved. The ligament margin is relatively long; none of the studied specimens preserves the ligamental plate. Single RV pairs the LV of specimen MWGUW ZI/63/0650. It is flat, subquadrate, oblique, with pointed umbo, projecting slightly above the hinge line. The ornament of both left and right valves is composed of concentric rugae, regular to irregular, moderately distinct.

OCCURRENCE: All specimens are from Bed O of the Shyrkala-Airakty section, which spans the top of the Lower and basal Middle Albian; according to ammonites it ranges up to the *A. intermedius* Zone.

*Actinoceramus concentricus concentricus*  
(Parkinson, 1819)  
(Text-fig. 28M–P)

1819. *Inoceramus concentricus* Parkinson, pp. 58, 59, pl. 1, fig. 4.

1996. *Actinoceramus concentricus concentricus* (Parkinson, 1819); Crampton, p. 35, pl. 3A–H; fig. 17. (with extensive synonymy)

TYPE: The holotype, by monotypy, is the original of Parkinson (1819, pl. 1, fig. 4). As mentioned by Crampton (1996), Parkinson's type has not been traced, and a neotype needs to be designated.

MATERIAL: 13 specimens; MWGUW ZI/63/0147

and 0646 from Bed O of the Shyrkala-Airakty section; MWGUW ZI/63/0611, 0613a, 0614, 0620, 0626, 0627, 0630, 0631, and 0634 from Bed J of the Sulu-Kapy section.

DESCRIPTION AND REMARKS: The strong inaequivalvness, parabolical outline, straight growth axis, long and straight anterior margin, narrow, pointed and curved umbo, and narrow posterior auricle characterise this subspecies and differentiate it from all other members of the Albian *Actinoceramus* lineage. It is well represented in the studied material; however, only single left valves are identifiable.

OCCURRENCE: The studied material is represented in the *A. intermedius* ammonite Zone.

*Actinoceramus sulcatus sulcatus* (Parkinson, 1819)  
(Text-fig. 29)

1962. *Actinoceramus sulcatus* Parkinson; Saveliev, p. 242, pl. 11, figs 1–8.

1962. *Actinoceramus sulcatus* Park. *inaequaliplicata* Saveliev morpha n.; Saveliev, p. 245, pl. 11, figs 5–7.

1962. *Actinoceramus sulcatus* Park. *aequaliplicata* Saveliev morpha n.; Saveliev, p. 245, pl. 11, figs 1–4.

1962. *Actinoceramus sulcatus* Park. aberration *flexiosocostatus* Saveliev aberr. n.; Saveliev, p. 245, pl. 11, fig. 8.

1962. *Actinoceramus sulcatoides* Saveliev sp. n.; pl. 9, figs 1–5.

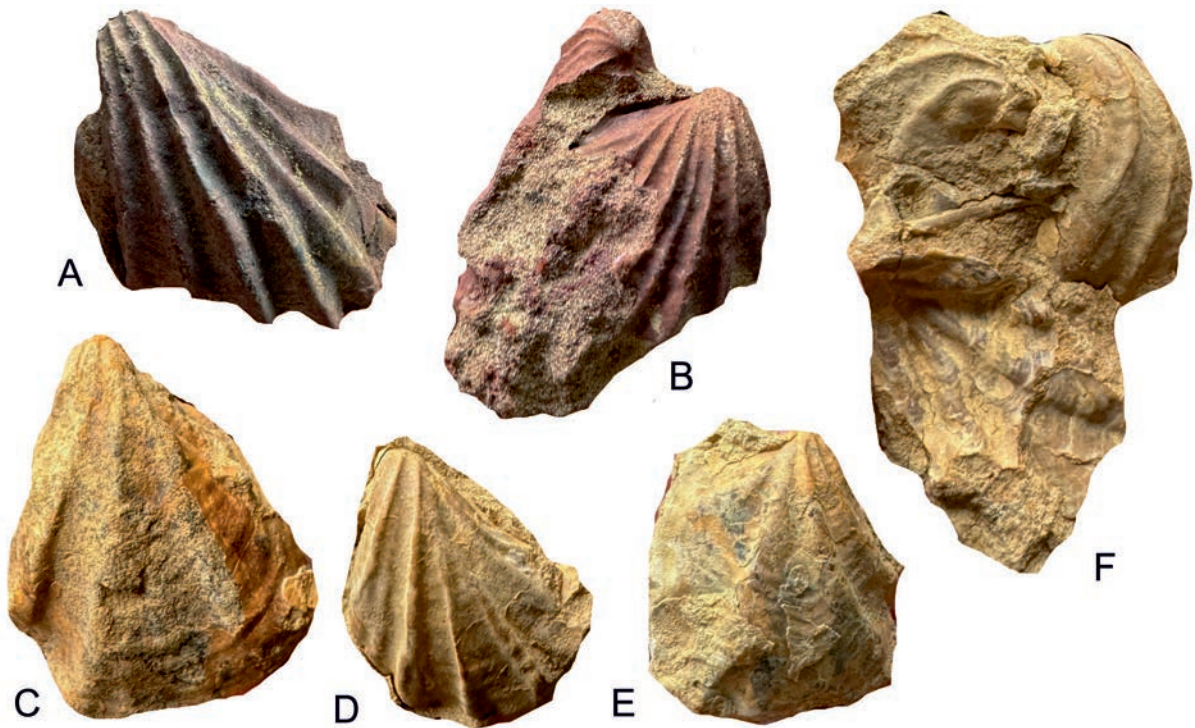
2009. *Actinoceramus sulcatus* forma *sulcatus* (Parkinson, 1819); Crampton and Gale, p. 100, figs 5.1–5.16, 6 (with complete synonymy).

TYPE: The lectotype, by the subsequent designation of Crampton and Gale (2009), is BMNH LL27504, the original of Parkinson (1819, pl. 1, fig. 5); refigured in Sowerby (1821, pl. 306, fig. 7), from the Gault Clay Formation ["blue marl"] near Folkstone, England, from the *Dipoloceras cristatum* Zone of the basal Upper Albian (see Crampton 1996).

MATERIAL: MWGUW ZI/63/1792 and 1800 from the Kush section; MWGUW ZI/63/1793–1795, and numerous unnumbered fragments, from Koksyrtau-Aksyrtau; MWGUW ZI/63/1295 from Bed E of the Shyrkala-Airakty section; MWGUW ZI/63/0119 from Bed 2 of the Shakh-Bogota section.

DESCRIPTION AND REMARKS: All of the specimens in our material belong to *Actinoceramus sulcatus* forma *sulcatus* (= morphotype A of Crampton





Text-fig. 29. *Actinoceramus sulcatus sulcatus* (Parkinson, 1819) forma *sulcatus* Crampton and Gale, 2009. A, B (left and right valve) – MWGUW ZI/63/1792, Kush section, equivalent of Bed [-D] of the Koksyrtau-Aksyrtau section; C–F – specimens from the Koksyrtau-Aksyrtau section; C – MWGUW ZI/63/1793, D – MWGUW ZI/63/1794, E (right valve) – MWGUW ZI/63/1795, F – rock fragment with *Actinoceramus* shell concentration. All figures are  $\times 1$ .

in Kennedy *et al.* 1999), following the subspecies subdivision of *A. sulcatus* by Crampton and Gale (2009). The morphs *inaequaliplicata*, *aequaliplicata* and the aberration *flexicostatus*, distinguished by Saveliev (1962) are variants within forma *sulcatus* and have no evolutionary meaning.

**OCCURRENCE:** The species has a pandemic distribution (see Crampton and Gale 2009), being known from the European Biogeographic Province, Gulf Coast Subprovince, North Pacific Province, northern margin of the Tethyan Realm and from the East African Subprovince. It is known from the *cristatum* and *pricei* ammonite zones of the Upper Albian (Crampton 1996; Crampton and Gale 2009).

*Actinoceramus sulcatus biometricus* Crampton, 1996  
(Text-fig. 28A–F)

1996. *Actinoceramus sulcatus biometricus* subsp. nov.;  
Crampton, p. 43, pl. 5, figs C–J.

**TYPE:** The holotype, by original designation, is BMNH LL17187a, the original of Crampton (1996, pl.

5, figs E, F, J) from the lower *Pervinqueria inflata* Zone of the Upper Greensand of Blackdown, Devon, England. The paratypes are BMNH L17192b, c, m; all from the type locality.

**MATERIAL:** Five specimens from Bed A of the Sulu-Kapy section; MWGUW ZI/63/0657, 0661–0663, and 0666; additionally, numerous fragments from the same concretions, belong apparently to the same taxon.

**DESCRIPTION AND REMARKS:** The general outline, the presence of the umbonal-ventral carina and the presence of weak radial folds makes the Mangyshlak specimens easily comparable with English types. The right valve is with rhomboidal outline, moderately inflated with maximum inflation along growth axis (sometimes giving an impression of a weak umbonal-ventral carina).

**OCCURRENCE:** *Actinoceramus s. biometricus* has a narrow range spanning the upper *Pervinqueria pricei* and basal *P. inflata* ammonite zones (see Crampton and Gale 2009). The Mangyshlak material

comes from Bed A of the Sulu-Kapy section, which is dated to the *P. pricei* ammonite Zone.

## Acknowledgements

WJK thanks Eliza Howlett of the Oxford University Museum of Natural History and David Sansom of the Department of Earth Sciences, Oxford, for technical support. Francis Amédro (Calais) gave invaluable advice on hoplitid taxonomy and intraspecific variation. We thank prof. Ludmila Kopaeovich, of the Moscow University, for her help during the Field Expeditions to Mangyshlak. Andy Gale and Francis Amédro provided inciteful reviews and saved us from error; Anna Żylińska provided meticulous editing.

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PLATES 1-13

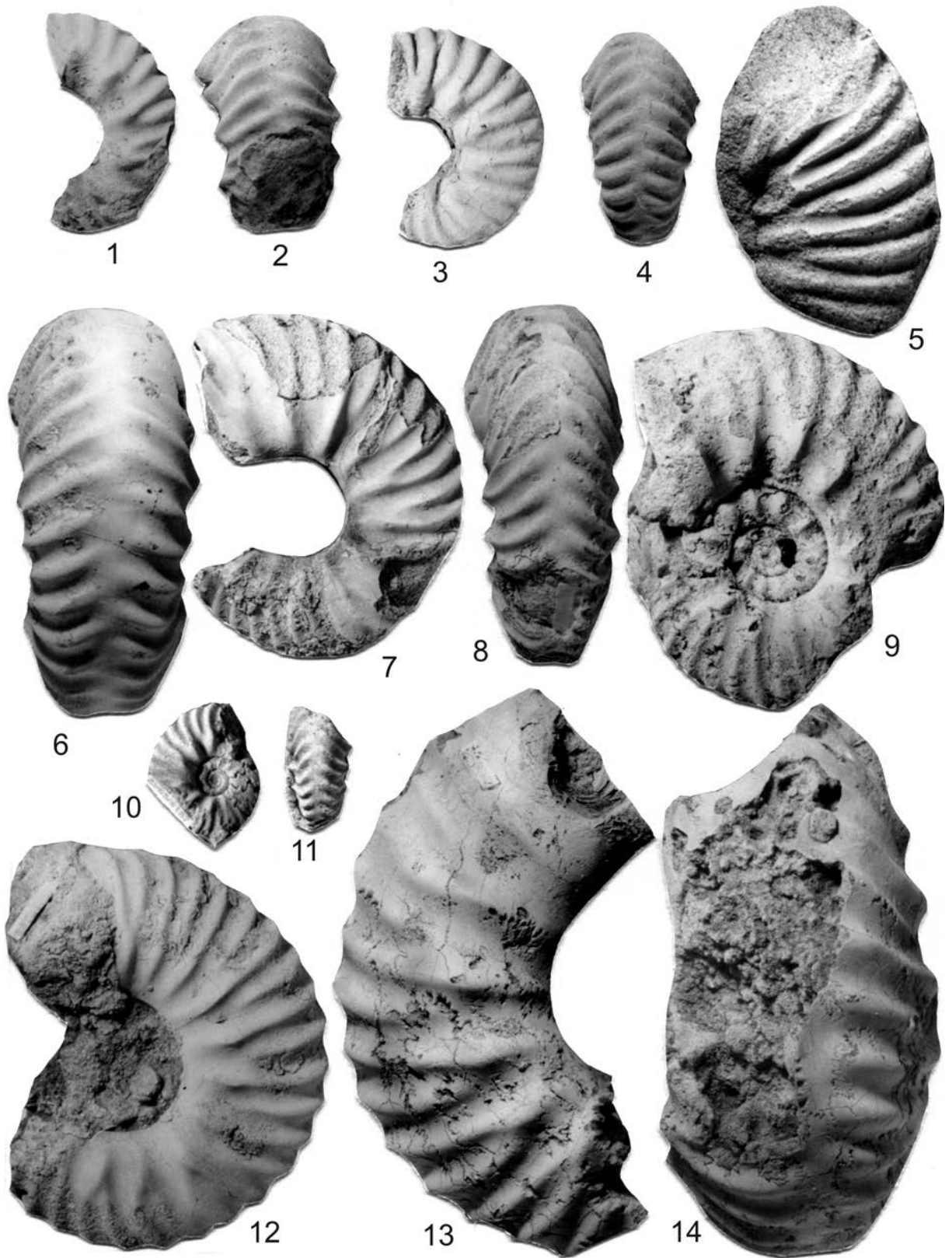


## PLATE 1

*Hoplites (Hoplites) benettianus* (J. de C. Sowerby, 1826)

1, 2 – MWGUW ZI/63/0177; 3, 4 – MWGUW ZI/63/0353; 5 – MWGUW ZI/63/0710; 6, 12 – MWGUW ZI/63/0361; 7, 8 – MWGUW ZI/63/0343; 9 – MWGUW ZI/63/0345; 10, 11 – MWGUW ZI/63/0157; 13, 14 – MWGUW ZI/63/0332. All specimens are from Shyrkala-Airakty; Figs 1, 2, 10, 11 are from the *Hoplites* Zone; Figs 3, 4, 6–9, and 12–14 are from Bed O; Fig. 5 is from Bed K.

All figures are  $\times 1$ .



## PLATE 2

*Hoplites (Hoplites) benettianus* (J. de C. Sowerby, 1826)

1, 2 – MWGUW ZI/63/0334; 3 – MWGUW ZI/63/0350; 4, 5 – MWGUW ZI/63/0711; 6, 7 – MWGUW ZI/63/0344; 8 – MWGUW ZI/63/0333; 9, 10 – MWGUW ZI/63/0357; 11, 12 – MWGUW ZI/63/0349. Figs 1–3, and 6–12 are from Bed O of the Shyrkala-Airakty section; Figs 4 and 5 are from Bed K of the Shyrkala-Airakty section.

All figures are  $\times 1$ .





1



2



3



4



5



6



7



8



9



10



11



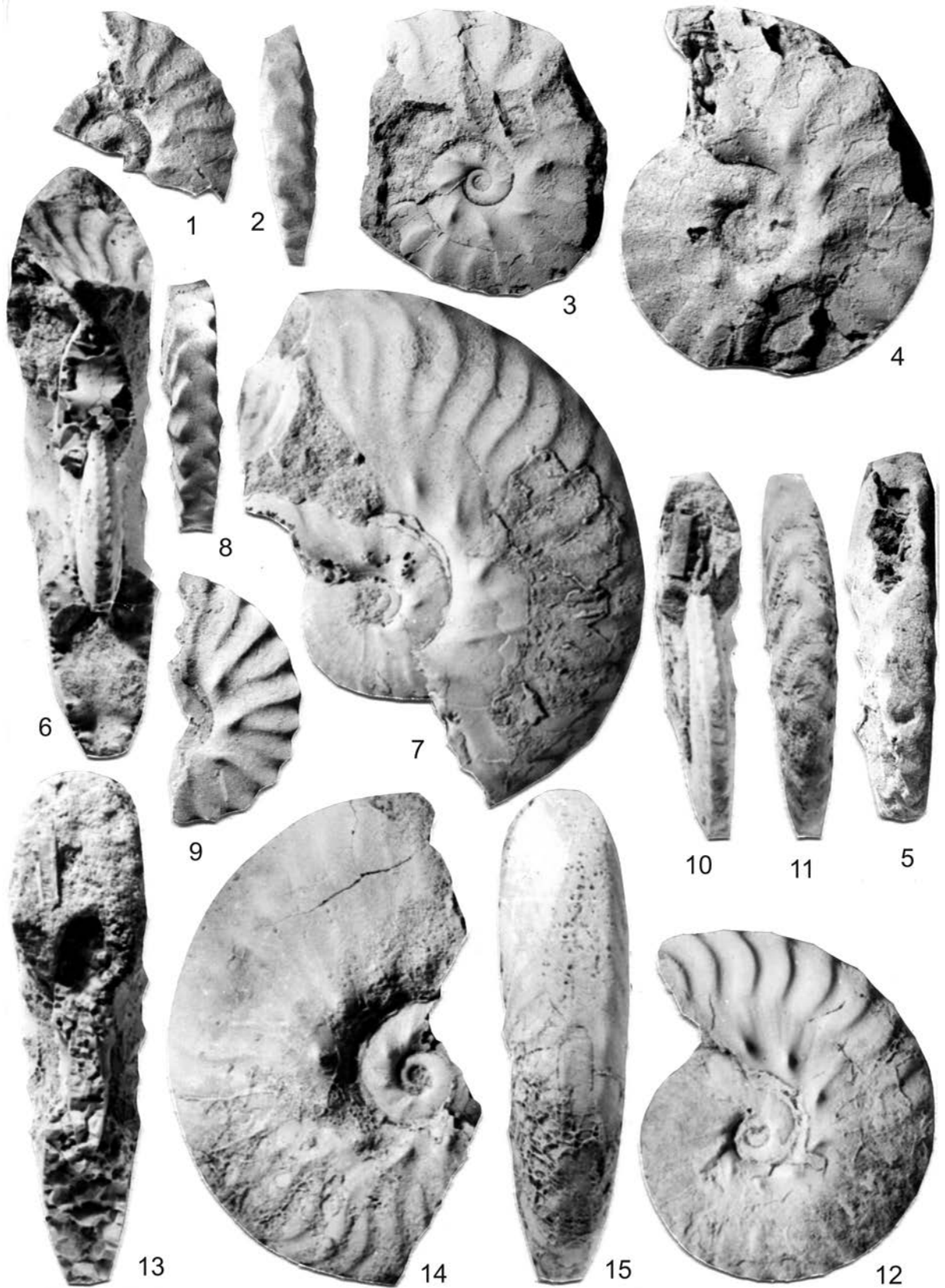
12

## PLATE 3

*Anahoplites rossicus* (Sinzow, 1910)

1, 2 – MWGUW ZI/63/0322; 3 – MWGUW ZI/63/0311; 4, 5 – MWGUW ZI/63/0312; 6, 7 – MWGUW ZI/63/0193; 8, 9 – MWGUW ZI/63/0307; 10–12 – MWGUW ZI/63/0290; 13–15 – MWGUW ZI/63/0291. Figs 1–5, 8, and 9 are from Bed F of the Sulu-Kapy section; Figs 6, 7, and 12–15 are from Bed D of the Koksyrtau-Aksyrtau section.

All figures are  $\times 1$ .



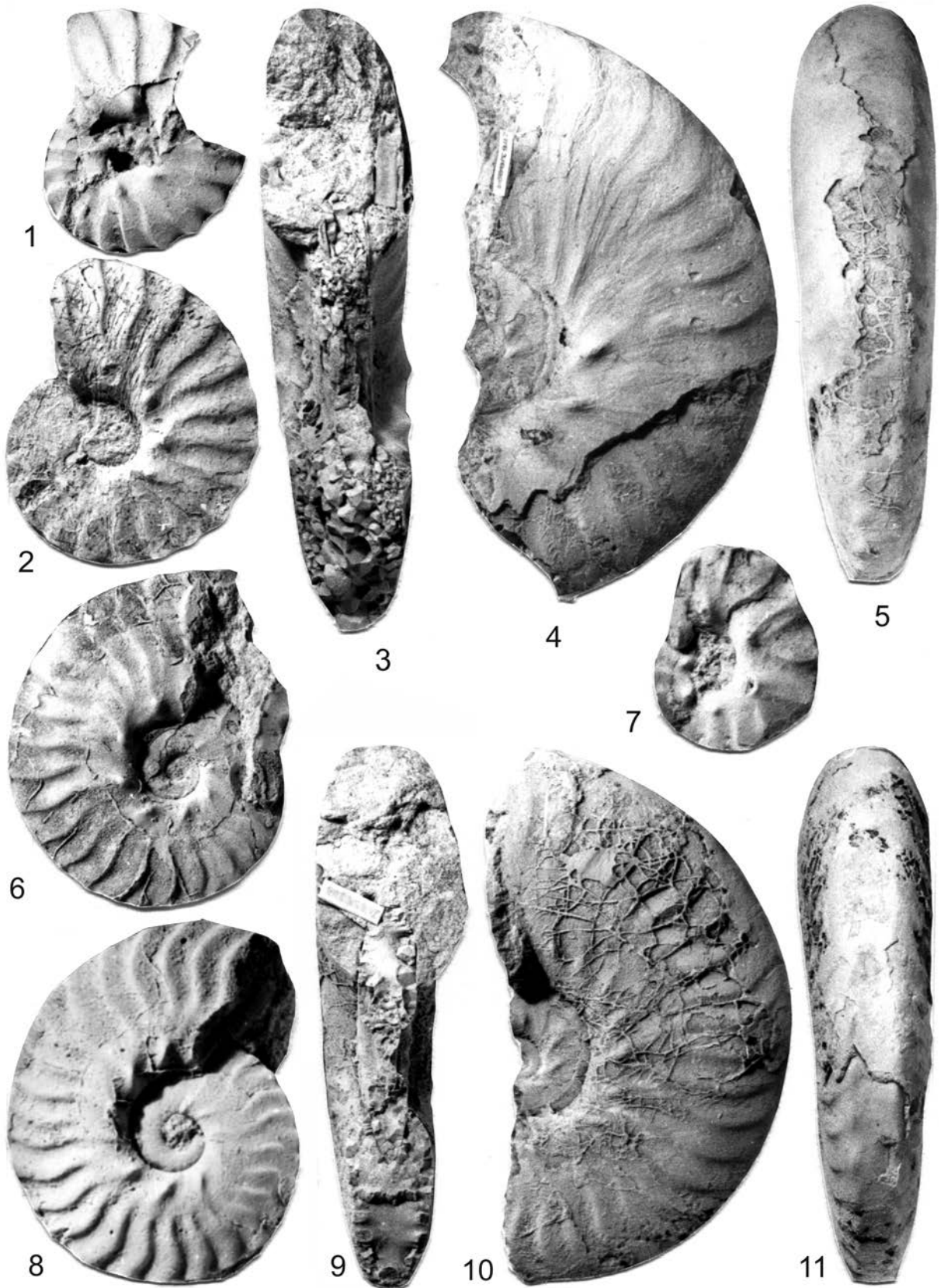


## PLATE 4

*Anahoplites rossicus* (Sinzow, 1910)

1 – MWGUW ZI/63/0319; 2 – MWGUW ZI/63/0028; 3–5 – MWGUW ZI/63/0001; 6 – MWGUW ZI/63/0365; 7 – MWGUW ZI/63/0551; 8 – MWGUW ZI/63/0306; 9–11 – MWGUW ZI/63/0298. Fig. 1 is from Bed F of the Sulu-Kapy section; Figs 3–5, and 6–11 are from Bed [-D] of the Koksyrtau-Aksyrtau section; Fig. 7 is from Bed E of the Sulu-Kapy section.

All figures are  $\times 1$ .



## PLATE 5

*Anahoplites rossicus* (Sinzow, 1910)

1–3 – MWGUW ZI/63/0093; 4, 8 – MWGUW ZI/63/0084; 5, 6 – MWGUW ZI/63/0753; 7 – MWGUW ZI/63/0192; 9 – MWGUW ZI/63/0303; 10 – MWGUW ZI/63/1291. Figs 1–3, 4–6, and 8 are from 40 m below Bed A of the Koksyrtau-Aksyrtau section; Figs 7 and 9 are from Bed [-D] of the Koksyrtau-Aksyrtau section; Fig. 10 is from Bed E of the Shyrkala-Airakty section.

All figures are  $\times 1$ .



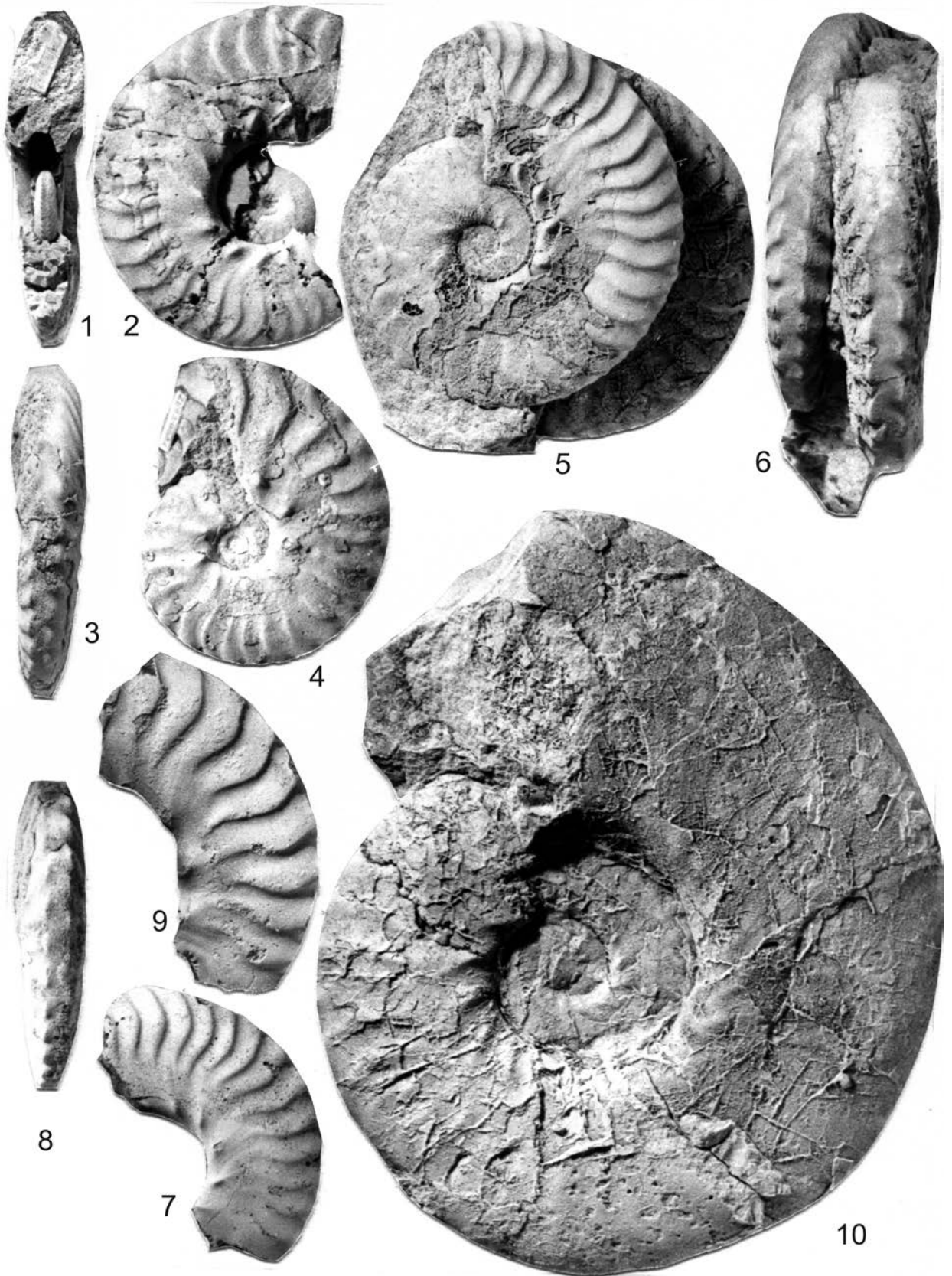


PLATE 6

*Anahoplites rossicus* (Sinzow, 1910)

1–3 – MWGUW ZI/63/1221; 4, 5 – MWGUW ZI/63/0301; 6, 7 – MWGUW ZI/63/0300; 8 – MWGUW ZI/63/0002. All specimens are from Bed [-D] of the Koksyrtau-Aksyrtau section.

All figures are  $\times 1$ .

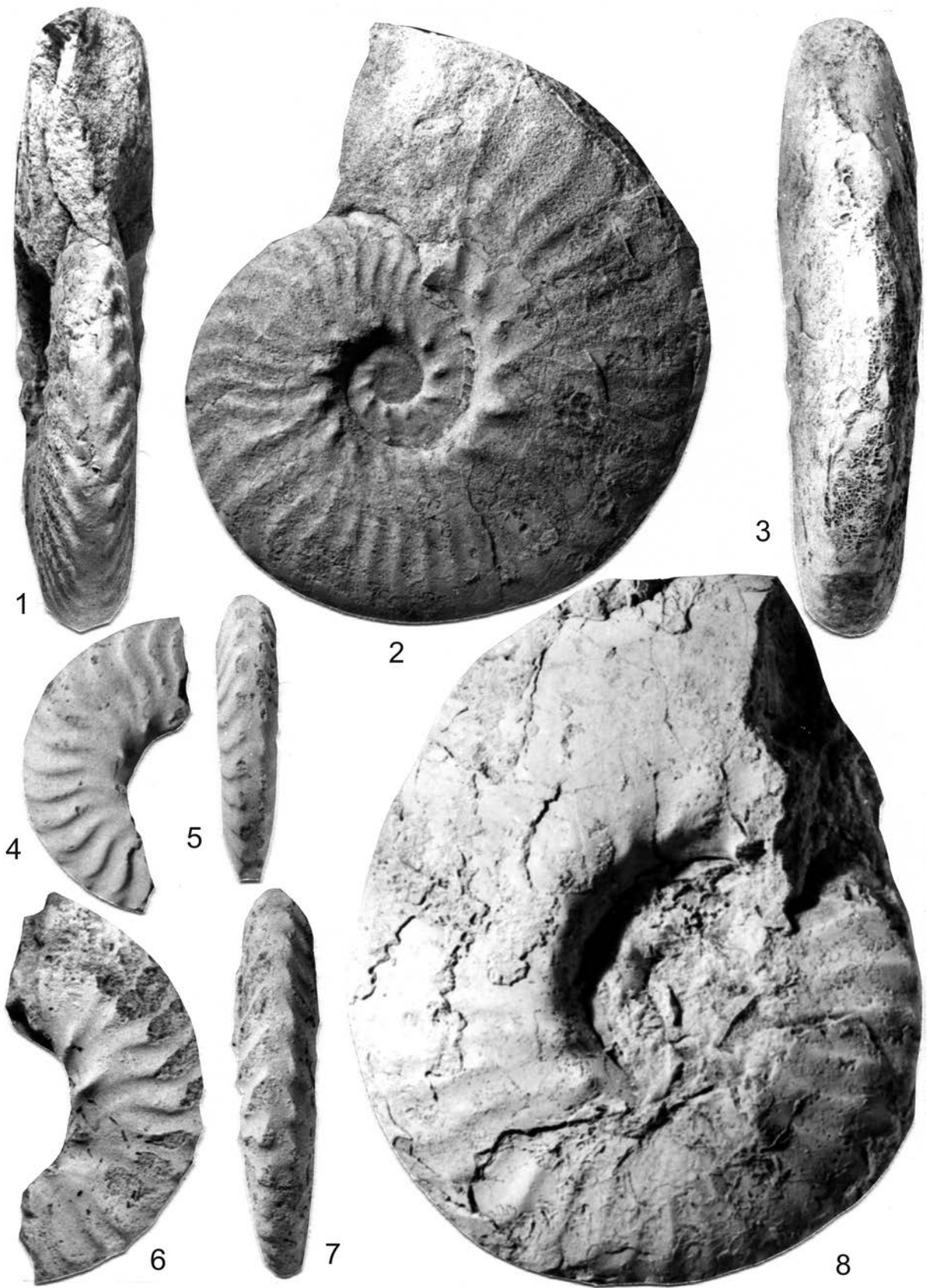


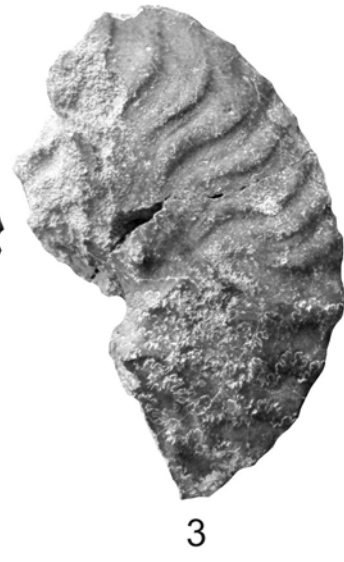
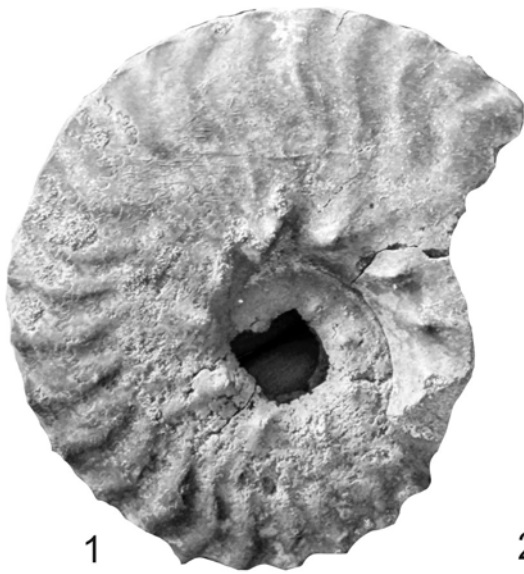


PLATE 7

*Semenoviceras michalskii* (Semenov, 1899)

1, 2 – MWGUW ZI/63/0103; 3, 4 – MWGUW ZI/63/0062; 5–7 – MWGUW ZI/63/0068; 8, 9 – MWGUW ZI/63/0108; 10, 11 – MWGUW ZI/63/0104. All specimens are from Bed 1 of the Shakh-Bogota section.

All figures are  $\times 1$ .



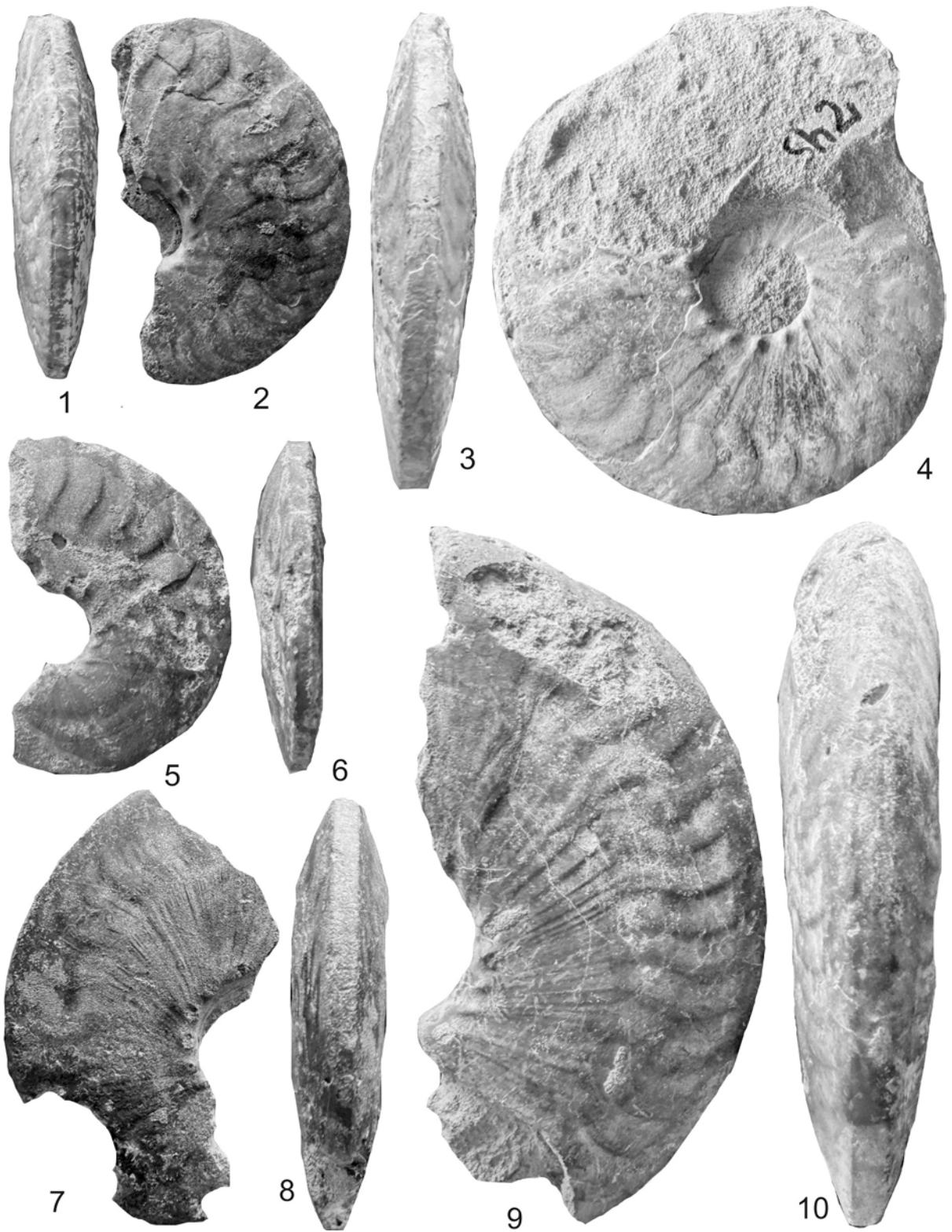
## PLATE 8

*Semenoviceras michalskii* (Semenov, 1899)

1, 2 – MWGUW ZI/63/0102; 3, 4 – MWGUW ZI/63/0127; 5, 6 – MWGUW ZI/63/0533; 7, 8 – MWGUW ZI/63/1766; 9, 10 – MWGUW ZI/63/0110. All specimens are from the Shakh-Bogota section; Figs 1, 2, 5–10 are from Bed 1, Figs 3 and 4 are from Bed 2.

All figures are  $\times 1$ .





## PLATE 9

*Semenoviceras michalskii* (Semenov, 1899)

1, 2 – MWGUW ZI/63/0096; 3, 4 – MWGUW ZI/63/0045; 5–7 – MWGUW ZI/63/1622; 8, 9 – MWGUW ZI/63/0081. Figs 1, 2 are from Bed 1B of the Shyrkala-Airakty section; Figs 3, 4 are from Bed 1A of the Kush section (stratigraphical equivalent of Bed 1A of the Koksyrtau-Aksyrtau section); Figs 5–7 are from Bed 1A of the Shyrkala-Airakty section; Figs 8, 9 are from Bed [-B] of the Koksyrtau-Aksyrtau section.

All figures are  $\times 1$ .



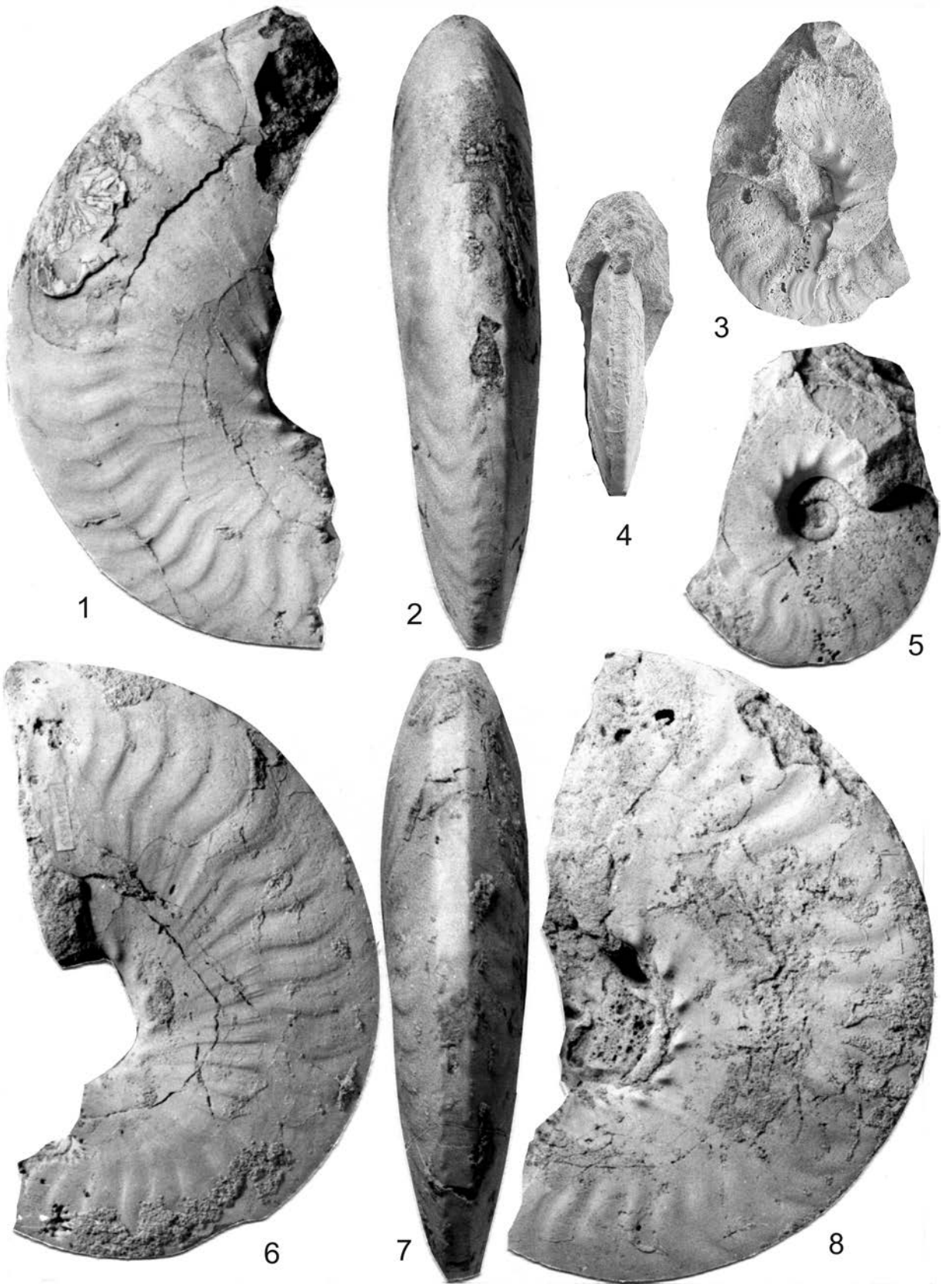
## PLATE 10

*Semenoviceras michalskii* (Semenov, 1899)

1, 2 – MWGUW ZI/63/0075; 3–5 – MWGUW ZI/63/0026; 6, 7 – MWGUW ZI/63/1633; 8 – MWGUW ZI/63/0041. All specimens are from Bed 1B of the Shyrkala-Airakty section.

All figures are natural size.





## PLATE 11

**1–7** – *Callihoplites vraconensis vraconensis* (Pictet and Campiche, 1860). 1–3 – MWGUW ZI/63/1324; 4, 5 – MWGUW ZI/63/1322; 6, 7 – MWGUW ZI/63/1318.

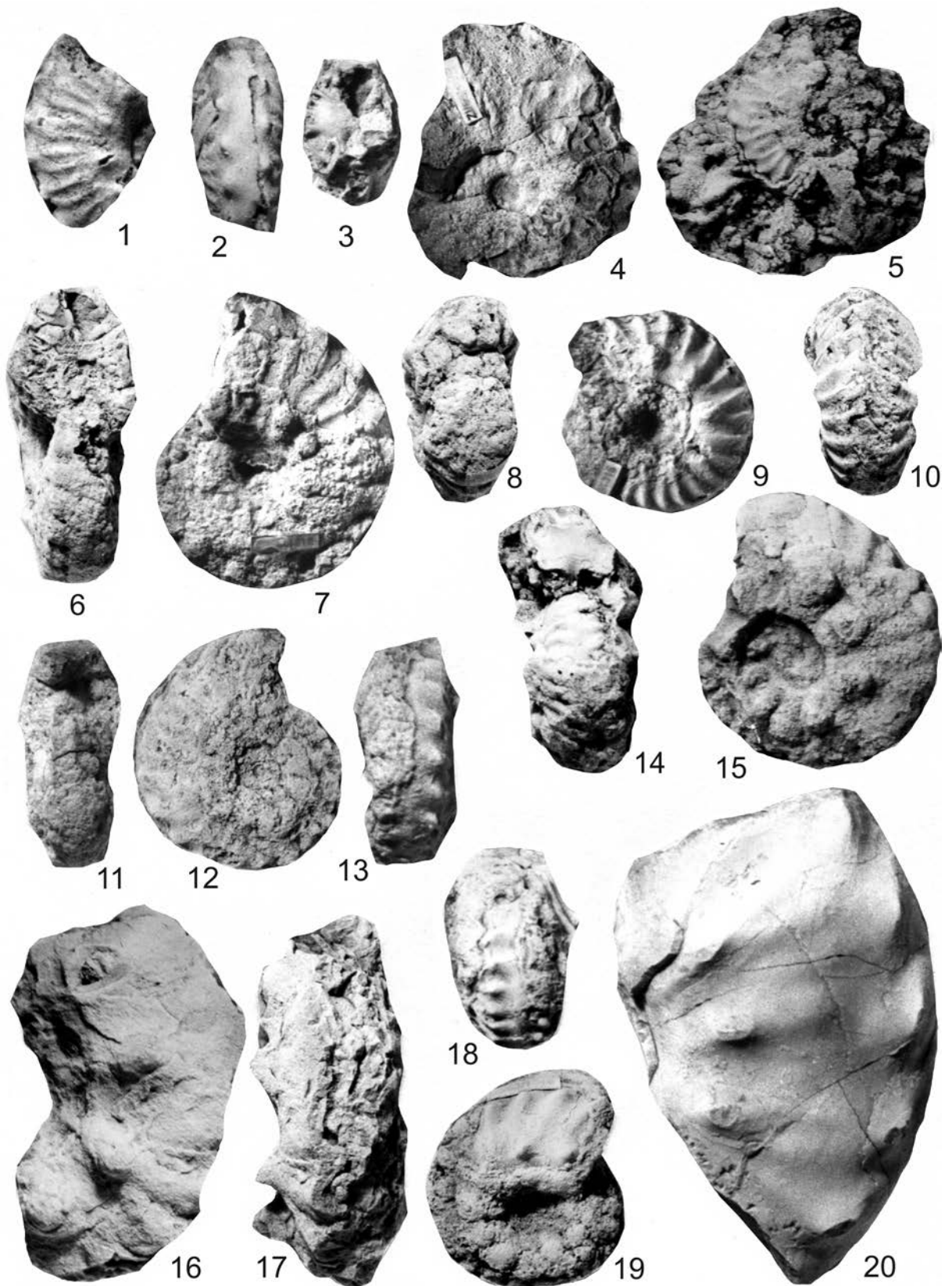
**8–15, 18, 19** – *Arrhaphoceras substuderi* Spath, 1928. 8–10 – MWGUW ZI/63/1316; 11–13 – MWGUW ZI/63/1434; 14, 15 – MWGUW ZI/63/1317; 18, 19 – MWGUW ZI/63/1319.

**16, 17** – *Arrhaphoceras* sp. MWGUW ZI/63/1315.

**20** – *Arrhaphoceras* cf. *precoupei* Spath, 1928, MWGUW ZI/63/1355.

All specimens are from the Besakty section. Figs 1–19 are from Bed 9; Fig. 20 is from Bed 14.

All figures are natural size.



## PLATE 12

**1–7** – *Sulcohoplites altifurcatus* Michailova and Saveliev, 1994. 1, 2 – MWGUW ZI/63/0576; 3–5 – MWGUW ZI/63/0587; 6, 7 – MWGUW ZI/63/0584. All specimens are from Bed J of the Sulu-Kapy section.

**8–11** – *Anahoplites planus* (Mantell, 1822). 8, 9 – MWGUW ZI/63/0572; 10, 11 – MWGUW ZI/63/0577. Both specimens are from Bed J of the Sulu-Kapy section.

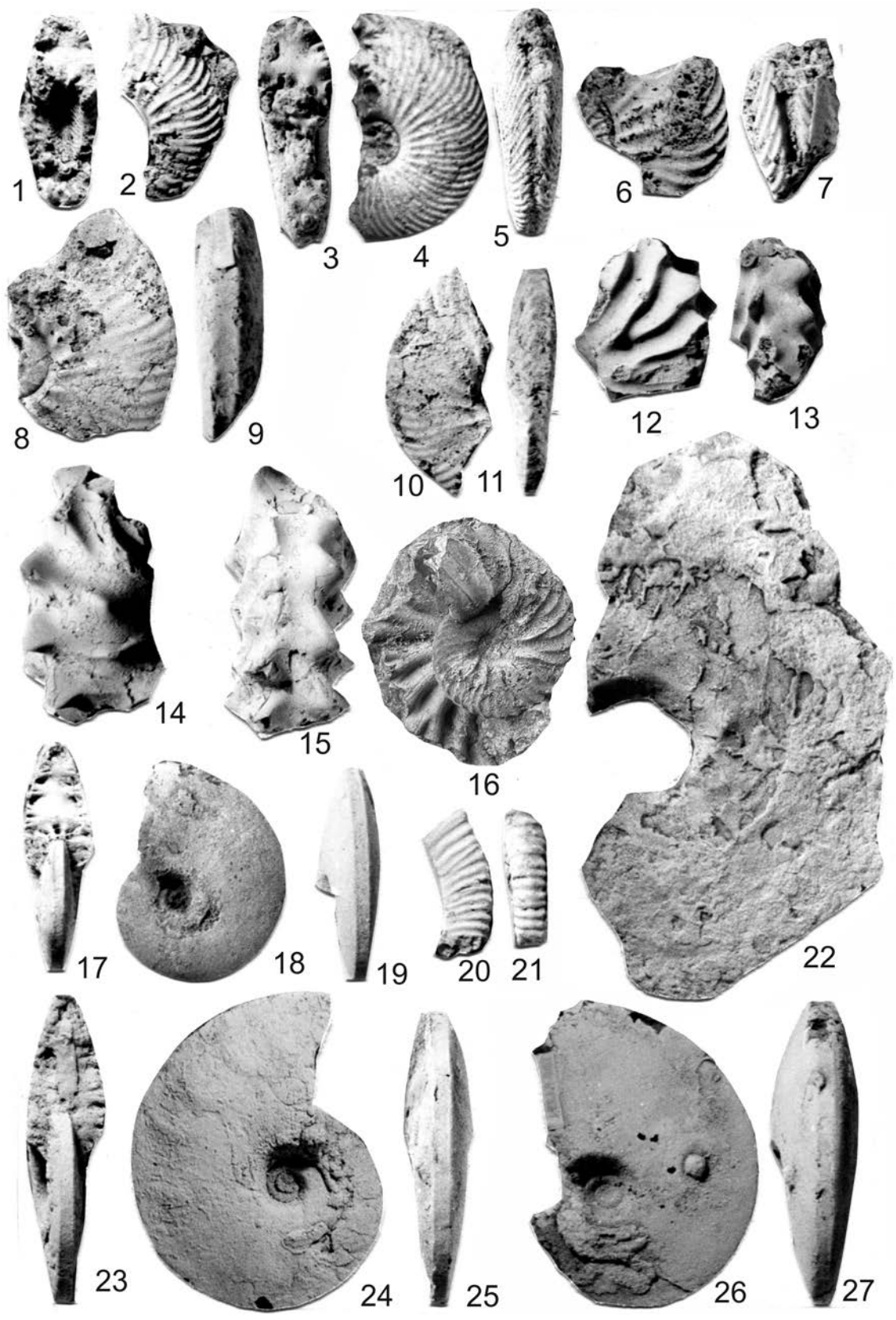
**12–16** – *Dimorphoplites beresovkaensis* Glazunova, 1968. 12, 13 – MWGUW ZI/63/0575; 14, 15 – MWGUW ZI/63/0581; 16 – MWGUW ZI/63/0580. All specimens are from Bed J of the Sulu-kapy section.

**17–19, 22–27** – *Placenticerias kolbajense* (Sokolov, 1967). 17–19 – MWGUW ZI/63/1329; 22 – MWGUW ZI/63/1483; 23–25 – MWGUW ZI/63/1312; 26, 27 – MWGUW ZI/63/1331. All specimens are from Bed 9 of the Besakty section.

**20, 21** – *Idiohamites* sp., MWGUW ZI/63/0567, from Bed A of the Sulu-Kapy section.

All figures are natural size.





## PLATE 13

**1, 2, 7–9** – *Hysterocheras orbigny* (Spath, 1922). 1, 2 – MWGUW ZI/63/0565, from Bed A of the Sulu-Kapy section; 7–9 – MNHN F. R04275, no. 5756 in the d’Orbigny collection, from Perte du Rhône, in the commune of Bellegarde-sur-Valserine, Ain, France, the original of d’Orbigny (1841, pl. 87, figs 1, 2).

**3–6, 10–12** – *Hysterocheras binum* (J. Sowerby, 1815). 3, 4 – MWGUW ZI/63/0566, from Bed A of the Sulu-Kapy section; 5, 6 – MWGUW ZI/63/0562, from Bed A of the Sulu-Kapy section; 10 – BMNH C53341, the original of Spath (1934, pl. 53, fig. 9), from the Gault Clay of Folkestone, Kent; 11, 12 – BMNH 43956, the holotype, the original of J. Sowerby (1815, pl. 92, fig. 3), from Pleistocene deposits at Bramerton, Norfolk, in eastern England.

**13** – *Pervinquieria (Deiradoceras)* sp. MWGUW ZI/63/0508, from Bed A of the Sulu-Kapy section.

**14–19** – *Hamites incurvatus* Brown, 1837. 14–16 – MWGUW ZI/63/1260, from Bed 1 of the Shakh-Bogota section; 17–19 – MWGUW ZI/63/1240, from Bed [-D] of the Koksyrtau-Aksyrtau section.

**20–22** – *Goodhallites goodhalli* (J. Sowerby, 1820). 20 – MWGUW ZI/63/0564; 21–23 – MWGUW ZI/63/0553. Both specimens are from Bed A of the Sulu-Kapy section.

All figures are  $\times 1$ .

