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Stratigraphy and ammonites of Cretaceous deposits of South-West Crimea

by

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With 16 plates and 4 text-figures

Zusammenfassung

54 Ammoniten-Arten aus Kreidelagerungen der sudwestlichen Krim werden beschrieben und abgebildet. Aufgrund der neuen Ammoniten-Funde aus dem früheren Valanginium wird das stratigraphische Schema der Unterkreide, besonders des Berriasiums und des Valanginiums, revidiert. Eine ausführliche Beschreibung des Untervalangium-Profils und auch des kombinierten Profils der Kreideablagerungen im Becken des Belbek-Flusses wird durchgeführt.

Schlüsselwörter: Ammoniten – Kreide – Krim – Stratigraphie.

Summary

54 species of ammonites occurring in the Cretaceous deposits of South-West Crimea are described and figured. The stratigraphical scheme of the Lower Cretaceous deposits, particularly the Berriasian and Valanginian stages, is revised according to the new finds of ammonites. The section of the Lower Valanginian is given in details, as well as a total section of the Cretaceous deposits in the River Belbek Basin.

Key words: Ammonites – Cretaceous – Crimea – Stratigraphy.

Contents

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Introduction

Marine Cretaceous deposits are widespread on the Crimean peninsula. They contain abundant and various fossils. In the South-West Crimea, Cretaceous, especially Lower Cretaceous, rocks form an independent type of the section which differs from those of other parts of the Crimea. Ammonites play the most important role in subdividing the sediments into stages and zones. Several publications are devoted to the Crimean ammonites. The most capacious among them are "The Lower Cretaceous sediments of Crimea and fauna occurring in them" (KARAKASH 1907), "Lower Cretaceous ammonites of the Crimea and North Caucasus" (DRUSHCHITS 1956), "Atlas of the Lower Cretaceous fauna of North Caucasus and Crimea" (1960), "Atlas of the Upper Cretaceous fauna of North Caucasus and Crimea" (1959). These publications became bibliographical rarities and do not reflect the contemporal knowledge about Cretaceous deposits of Crimea and their fauna.

In this paper we try to describe and analyse the materials accumulated on Cretaceous ammonites in the River Belbek Basin (South-West Crimea) (Text-fig. 1). Despite many years of geological research conducted by the staff of the Moscow State University (MGU), the St.-Petersburg State University (SPGU) and the St.-Petersburg State Mining Institute (SPGGI) a subdivision into stages and substages of the Cretaceous deposits of this region, especially of those of the Berriasian and the Valanginian, was not carried out up today.

The ammonites described in this paper allow to correlate the intervals of the Cretaceous section of the Crimea with those of the same age of the stratotype areas. This correlation can be made for the Berriasian, the Lower Valanginian, the Upper Hauterivian, the Upper Albian, and some of the Upper Cretaceous stages.

Some of the described species have an important stratigraphical value, but often their taxonomical status is not clear, therefore they are described here in nomenclature. Descriptions of some ammonite species are supplied for comparison by figures reproductions of those species coming from other regions of the Mediterranean province (Armenia etc.).

This publication bases mainly on collections of ammonites made by students and teachers of the St.-Petersburg Mining Institute for practical training. Moreover, additional materials came from collections of A. A. ATABEKIAN (Armenia, North Caucasus, and West Kopetdag), N. I. KARAKASH (Crimea), K. N. PAFFENGOLTS and V. T. HAKOBIAN (Armenia), V. P. RENGARTEN and N. A. TUR (North Caucasus), and V. M. NERODENKO and V. G. KLIKUSHIN (Crimea).

Due to the great volume of material, ammonite species are here described briefly; lobe lines are not described and not figured. The authors agree with the system of the Ammonoidea proposed by C. W. WRIGHT (1981). Berriasian and Hauterivian ammonites are described by T. N. BOGDANOVA and V. V. ARKADIEV, Lower Valanginian ones by E. YU. BARABOSHKIN, Upper Albian and Upper Cretaceous ones by A. A. ATABEKIAN.

Text-fig. 1. Map of the Crimean peninsula.

The other fossils have been identified by the following specialists: belemnites: G. Ya. Krymgolts (SPGU), bivalves: T. N. Bogdanova (VSEGEI) and A. A. Yakushina (VSEGEI), gastropodes: M. A. Golovinova (MGU) and A. I. Korobkov (VSEGEI), brachiopodes: S. V. Lobacheva (VSEGEI) and M. V. Titova (VSEGEI), corals: I. Yu. Bugrova (SPGU), echinoids: N. A. Tur (VSEGEI), and crinoids: V. G. Klikushin (St.-Petersburg Palaeontological Laboratory).

The collection of the ammonites described in this paper is kept by the Museum of St.-Petersburg Mining Institute under number 330, by the Central Scientific-Research Geological Exploration Museum (CNIGR Museum) under number 9431, 8104, 8304, 3962, 10840, 12943, 12944, 12945 and 12946, and by the Museum of the Moscow State University under number 94.

The majority of the photos is made by B. S. Pogrebov (SPGU) and by the photolaboratories of VSEGEI and MGU. Translation of the manuscript was made by T. Yu. Nikolaenko.

Stratigraphy

The River Belbek Basin is part of the north-west wing of the Kachinskoe anticlinal rise of the Crimea mountains (Text-fig. 2). Its core is formed by complexly folded Triassic to Middle Jurassic deposits and its wings are made up by weakly dislocated Cretaceous and Paleogene sediments. In the River Belbek Basin, Lower Jurassic deposits are only represented by fossiliferous two- or three-component terrigenous flysh deposits. Cretaceous and Paleogene rocks overlie these deposits with a structural unconformity to form a sloping monoclynal dipping 10–15° NW.

The stratigraphy of the Cretaceous deposits of the River Belbek Basin has been worked out by many researchers (Drushchits & Yanin 1958; Gorbachik et al. 1975; Bogdanova et al. 1981; Kravtsov & Shalimov 1978, 1982; Klikushin 1981, 1985). The most detailed description of the Cretaceous deposits in the north-west part of the Kachinskoe Rise is given in the work of the geological staff of the Moscow State University edited by O. A. Mazarovich & V. S. Mileev (1989).

Cretaceous system

The Lower Cretaceous

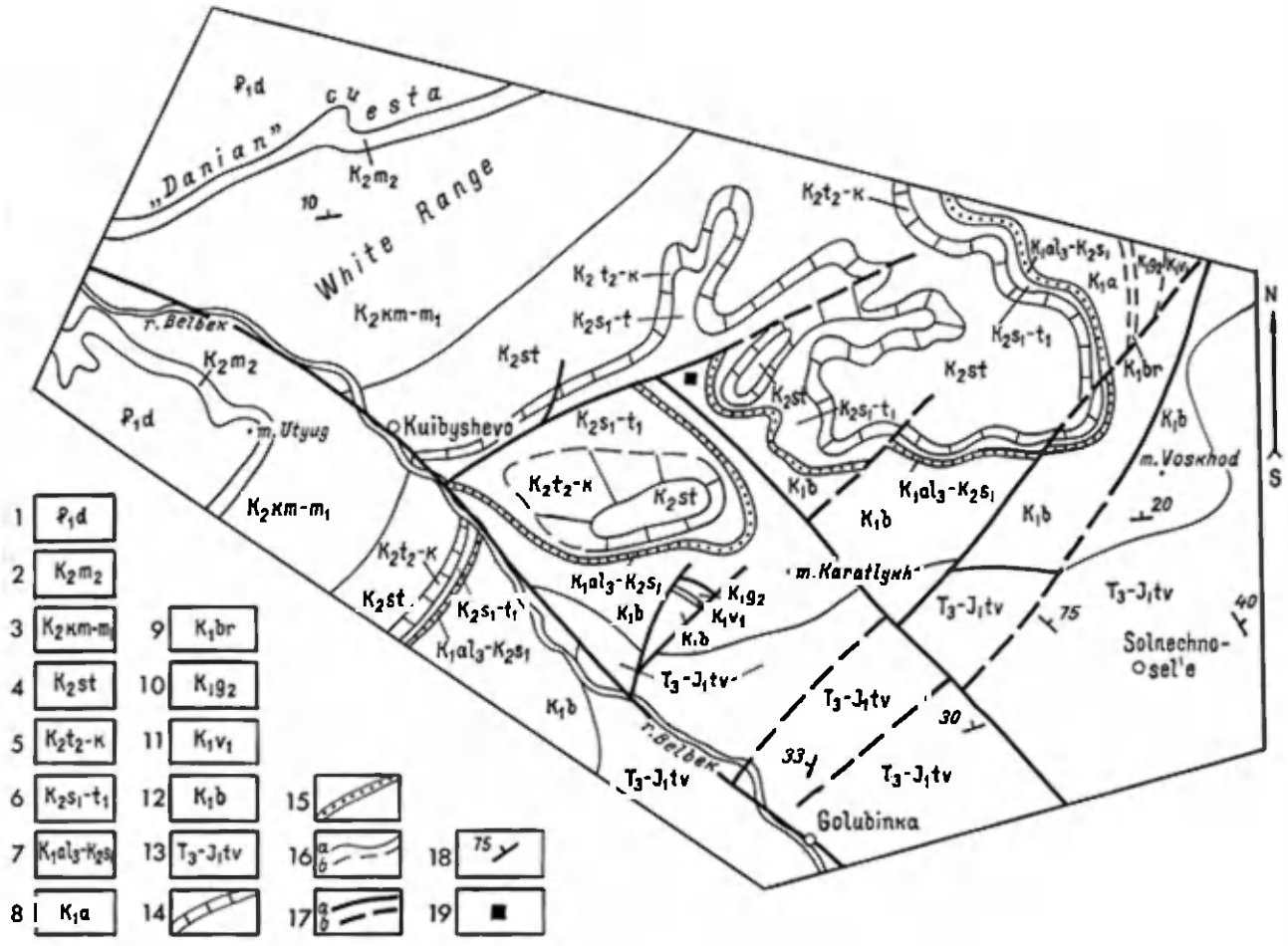
The Lower Cretaceous deposits of the River Belbek Basin differ sharply in the lithological aspect from deposits of the same age from the other Crimean regions. Thus the deposits consisting of the Berriasian, Valanginian, Hauterivian, and Albian are described here separately (Text-fig. 3).

Berriasian stage

Berriasian deposits overlie Lower Jurassic ones with a sharp structural unconformity. It is a transgressive complex formed by terrigenous and carbonate rocks. According to the lithological peculiarities it is divided into several units.

At the base of the section polymictic conglomerates occur. Conglomerates are reddish-grey and greyish-brown. The pebbles are badly to moderately rounded and unsorted. They mainly consist of quartz, dark-coloured sandstones and siltstones. Cement consists of sand and clay. In the upper part of the section there occur lenses of yellow coarse sandstones of a thickness up to 3 m among the conglomerates. Fossils are extremely rare in the conglomerates. According to data presented by A. G. Kravtsov (Kravtsov & Shalimov 1982) remains of the bivalve *Myophorella loewinson-lessingi* (Renng.) were found in the cement of the conglomerates in the Orekhovy ravine. In the cement of the conglomerates exposed in the Belbek river-bed 200 m upstream from the mouth of the Ulyanovski ravine the coral *Axosmilia kobyi* (Ang. d'Oss.) (identified by I. Yu. Bugrova) was found. Near the village of Golubinka (Mazarovich et al. 1989) the foraminifera *Hoeglundina caracolla caracolla* (Roem.) were found. All these forms are not restricted to the Berriasian conglomerates. The thickness of the conglomerates is 30 to 40 m.

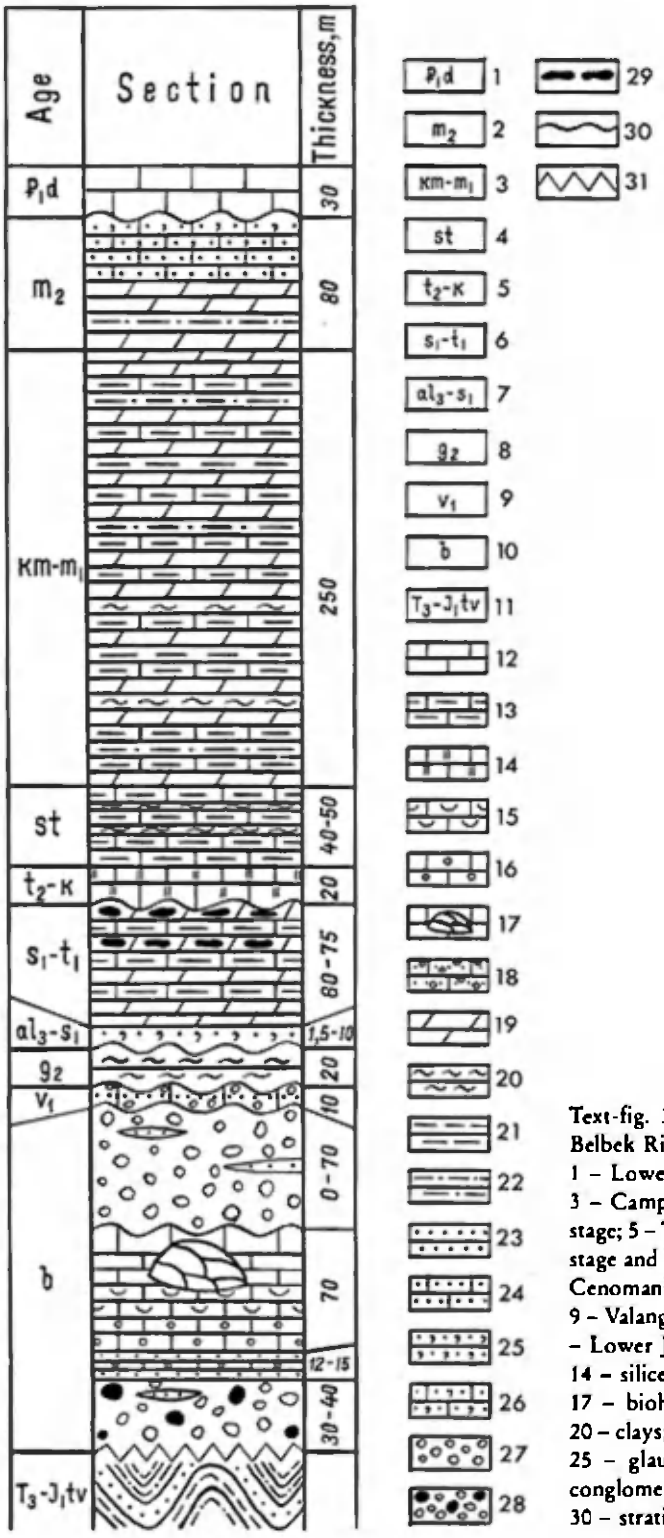
The upper part of the section can be subdivided in: 1) the sandstones interbedded with limy sandstones and limestones, 2) carbonates, and 3) quartzose conglomerates.



Text-fig. 2. Geological map of the middle reaches of the Belbek River. Scale 1 : 50,000.
1 – Lower Paleogene, Danian stage; 2 – Maastrichtian stage, upper substage; 3 – Campanian stage and Maastrichtian stage, lower substage; 4 – Santonian stage; 5 – Turonian stage, middle substage and Coniacian stage; 6 – Cenomanian stage and Turonian stage, lower substage; 7 – Albian stage, upper substage and Cenomanian stage, lower substage; 8 – Aptian stage; 9 – Barremian stage; 10 – Hauterivian stage, upper substage; 11 – Valanginian stage, lower substage; 12 – Berriasian stage; 13 – Upper Triassic – Lower Jurassic (tavricheskaya series); 14 – strata of siliceous limestones; 15 – strata of glauconite sandstones; 16 – geological boundaries (a – proved, b – supposed); 17 – faults (a – proved, b – supposed); 18 – attitude (strike and angle of dip); 19 – position of SPGGI camp.

The first section is represented by grey and greenish-grey fine-grained sandstones and by grey detrital, often oncolitic limestones. In the area of the village Solnechnosel'e the essential part of this unit consists of sandy oncolitic limestones. A great amount of various fossils has been found here: ammonites – *Dalmasiceras crassicostatum* (Djan.), *Biasaloceras liebigi* (Oppel), *Haploceras* ex gr. *elimatum* (Oppel), *Euthymiceras* (?) ex gr. *euthymi* (Pictet), *Malbosiceras* (?) sp., *Protetragonites tauricus* (Kulj.-Vor.), *Spiticeras orientale* (Kil.), *S. multiforme* Djan., *Neocosmoceras* sp. and others; bivalves – *Gervillaria allaudiensis* (Math.), *Gervillella anceps* Desh., *Protocardia sphaeroidea* (Forb.), *Cucullaea gabrielis* Leym., *Sphaera belbekensis* Yanin, *Antiquilima dubisiensis* Pict. & Camp. and others; brachiopods – *Belbekella airgulensis* Moiss., *B. mutabilis* Lobatsch., *B. minor* Lobatsch., and others; gastropods – *Ampullospira cossmanni* (Pcel.), *Jaccardiella* sp., *Scurria balaclavensis* Pcel. and others; belemnites – *Duvalia lata* (Blainv.); echinoids – *Pygurus rostratus* Ag. and others. Index ammonites define Berriasian age of these strata. Their thickness is 12 to 15 m.

Carbonate beds include some distinctive members (from bottom to top): a) oncolitic limestone member, b) member of bioclastic limestones, c) member of bioherm limestones. The most complete sections can be found on the southern slope of Mt. Voskhod near the village of Solnechnosel'e and in the Kabanii ravine.



Text-fig. 3. Total stratigraphical section of the Cretaceous sediments in the Belbek River Basin.

1 – Lower Paleogene, Danian stage; 2 – Maastrichtian stage, upper substage; 3 – Campanian stage and Maastrichtian stage, lower substage; 4 – Santonian stage; 5 – Turonian stage, middle substage and Coniacian stage; 6 – Cenomanian stage and Turonian stage, lower substage; 7 – Albian stage, upper substage and Cenomanian stage, lower substage; 8 – Hauterivian stage, upper substage; 9 – Valanginian stage, lower substage; 10 – Berriasian stage; 11 – Upper Triassic – Lower Jurassic (tavricheskaya series); 12 – limestones; 13 – clay limestones; 14 – siliceous limestones; 15 – bioclastic limestones; 16 – oncolite limestones; 17 – bioherm limestones; 18 – oncolite sandy limestones; 19 – marlstones; 20 – clays; 21 – argillites; 22 – aleurolites; 23 – sandstones; 24 – lime sandstones; 25 – glauconite sandstones; 26 – lime glauconite sandstones; 27 – quartz conglomerates; 28 – polymictic conglomerates; 29 – concretions of cherts; 30 – stratigraphic unconformity; 31 – structural unconformity.

The massive oncolitic and well-bedded limestones are grey to yellowish-grey. The sizes of the oncolite vary from 0.5–1.0 mm to 1.5–2.0 cm (section near the village of Solnechnosel'e).

The massive bioclastic limestones are light grey with some admixture of quartz grains (up to 5%). They contain detritus of thick bivalve and brachiopod shells, crinoids, corals, bryozoans, and algae.

Bioherm limestones usually contain moderately large bodies of bioherms (up to 3- 5 m high and 4 m long). The larger ones occur rarely (the Ulyanovskii bioherm is about 8 m high and about 15 m long). Bioherms consist of algae and hermatypic corals. From the Ulyanovskii bioherm the following corals have been determined: *Thamnaraea mammelonata* Turn., *Dermosmilia cretacica* Turn., *Placophyllia grata* Bugrova sp. nov. Other organisms living on the reef are: the brachiopods *Weberithyris moisseevi* (Weber), *Terebrataliopsis quadrata* Smirn.; the crinoids *Heberticrinus heberti* (de Lor. in Pict.); the echinoids *Balanocidaris maresi* (Cott.). The intermounds between bioherms are filled with bioclastic limestones with fragments of corals and algae, brachiopod shells, fragments of crinoid stems and echinoid spines. In some areas, for example in the Hydrogeological ravine (basin of the River Kacha), gastropod limestones occur, which contain *Pseudotylostoma* sp., *Triptyxis belbekensis* Fogdt, *Upella monocarinata* Pcel.

The complex of fossils from the carbonate unit also includes a number of corals: *Cyathophora almae* Kusm., *Dimorphocoenia alpina* (Koby), *Stylosmilia alpina* Koby, *Stylina regularis* From., *Thecosmilia tobleri* Koby, *Heliocoenia variabilis* Etallon, *Dimorphastraea fungiomorpha* Kusm., *Dimorpharaea burulchiensis* Kusm. and others.

The carbonate beds do not contain the typical Berriasian fossils. Therefore they are attributed only provisionally to the Berriasian. The thickness of these strata in the River Belbek area is up to 70 m.

The quartzose conglomerates crop out on the southern slope of Karatlykh Mts. (Rifovaya). These strata are made up of small and middle finely rounded pebbles and quartz. Sometimes layers and lenses of gravelstones and coarse-bedded sandstones together with fragments of charred wood occur. These beds lie with an unconformity on the underlying limestones. Their thickness varies from 0 to 70 m.

The quartzose conglomerates are attributed to the Berriasian stage, according to their stratigraphical position below deposits with ammonites of the Early Valanginian.

Valanginian stage

Lower substage

This subdivision consists of 12.5 m yellowish-grey to brown oncolitic and sandy limestones with gravel recently described as "pudding" limestones (Kravtsov & Shalimov 1982), and attributed to the Valanginian stage. In the region referred to they have been found in the Sbrosovyi ravine, where they lie with an unconformity on the Berriasian quartz conglomerates and where they are followed by clays with an Hauterivian fauna. They also appear in the Hydrogeological ravine.

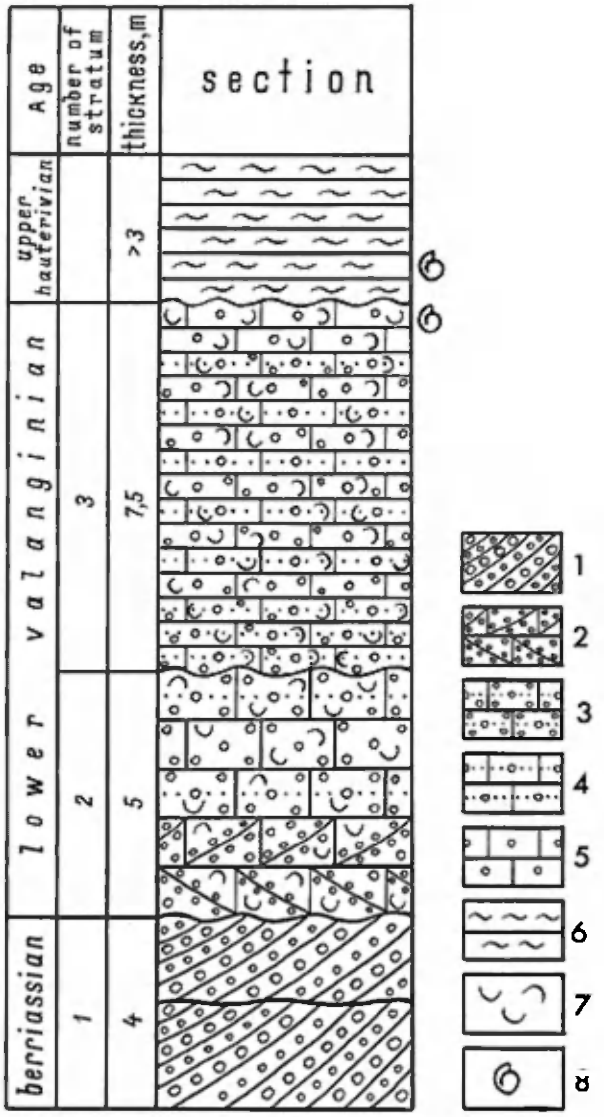
The most detailed investigation of this limestone member has been carried out in Sbrosovyi ravine, where it contains a number of various fossils (bivalves, brachiopods, corals, belemnites and ammonites).

In the lower part of the limestone section A. G. Kravtsov has found *Amphidonte subsinuata* (Leym.), which is characteristic both for the Valanginian and the Hauterivian of Crimea. T. N. Smirnova has identified the brachiopods *Terebrataliopsis quadrata* Smirn., *Zeillerina baksanensis* Smirn., *Dictyothyris picteti* Smirn. and *Symphyothyris yailensis kajnautensis* (Moiss.) here. T. N. Smirnova has considered the above mentioned fossils to indicate a Valanginian age.

Belemnites (identified by N. K. Gorn) are represented by the following species: *Duvalia lata* Bl., *D. dilatata* Bl., *D. emericii* Rasp., *D. polygonalis* Bl., *D. binervia* Rasp., *Conobelus conicus* Bl., *Pseudobelus bipartitus* Bl. In her opinion these species also indicate the Valanginian.

V. V. Drushchits and B. T. Yanin considered these limestones to belong to the Early Hauterivian (Gorbachik et al. 1975; Drushchits & Yanin 1958) basing on identification of the ammonite *Lyticoceras* cf. *amblygonium* Neum. & Uhl.

The bivalves *Prohinnites renevieri* (Coq.) (attributed by T. N. Bogdanova) and corals *Fungiastraea* cf. *tendagurensis* Dietr. (attributed by I. Yu. Bugrova) have been found in these limestones by V. V. Arkadiev. In the Hydrogeological ravine (River Kacha Basin) in the same limestones the bivalve *Neithea atava* Roem.



Text-fig. 4. The section of the Lower Valanginian sediments in the Sbrosovyi Ravine in the Belbek River Basin.
1 – quartz conglomerates and gravelstones with cross-bedding; 2 – oncolite grave-pebble limestones with cross-bedding; 3 – oncolite gravel-sand limestones; 4 – oncolite limestones with sand impurity; 5 – oncolite limestones; 6 – clays; 7 – fragments of shells of invertebrates; 8 – levels of the fossils findings.

(attributed by T.N. Bogdanova) have been also found by V.V. Arkadiev. T.N. Bogdanova and I.Yu. Bugrova have concluded that bivalves and corals occur both in the Valanginian and in the Hauterivian.

In 1992 a section of the limestone member exposed in the Sbrosovyi ravine has been studied in detail by E. Yu. Baraboshkin, R. A. Shchi-koldin and V. V. Arkadiev. The description of the upper part of Berriasian quartz conglomerates is given below (Text-fig. 4). Ammonite determination has been made by E. Yu. Baraboshkin. Petrographical descriptions have been made by V. I. Alekseev (SPGGI).

1. Pebble to cobble quartzose conglomerates and gravelstones with coarse cross-bedding caused by interchanging sandy gravelstone and conglomerate laminae.

Petrographical study of thin sections of gravelstones from the lower part of the member showed that they consist of quartz grains (40%) 0.02 to 7.0 mm in diameter, poorly rounded, nonsorted, highly cataclased. Gravelstones are matrix-supported. Matrix (60%) consists of illite, kaolinite and carbonate. The latter is partially recrystallized to form blocks of poikilitic cement.

Towards the top of the member, the grain sizes decrease, the cement composition becomes more hydromicaceous. The thickness of the member is 4 m.

2. Yellowish-greyish-brown oncolitic limestones parallel or sometimes cross-bedded, ferruginous, interbedded with pebble- and gravel-bearing limestones.

The contact between Member 1 and Member 2 is erosional. Thin sections of an oncolitic gravel-bearing limestone from the bottom part of the member reveal that clasts content is 40%. 95% of clasts are medium-rounded quartz gravel and pebbles 1.0 to12.0 mm in diameter. 5% are quartz silt and sand grains 0.01 to 1.0 mm in diameter. Quartz grains are coated by carbonate peels (10%). Carbonate grains (44%) are represented by: 1) irregular-shaped oncoids 0.1 to 1.5 mm in diameter; 2) coated skeletal fragments of bivalves, crinoids, ammonites and corals (20%). Cement (5%) consists of limonite and goethite in form of peels and micronodules. The latter are usually smaller than 0.001 mm, rarely up to 0.1 mm.

A thin section sampled from the upper part of the member shows that the rock is an oncolitic limestone with admixture of quartz pebbles, gravel and sand. Quartz grains comprise 10% of the total rock volume. These are medium-rounded, well sorted quartz gravel (1 to 2 mm, 7%), silt and sand grains (0.01 to 0.7 mm, 4%). Carbonate grains (20%) are represented by 1) ferruginous oncoids of irregular shapes (10%), 0.05 to 1.0 mm in diameter; 2) slightly rounded fragments of bivalves, ammonites, gastropods and echinoderms (10%). Calcite cement comprises 70% of the rock volume.

From bottom to top of the member both the content and the sizes of grains decrease gradually, the iron content and degree of recrystallization of oncoids and calcite cement increase. The top of the member is eroded. The thickness of the member is 5.0 m.

3. Yellowish-greyish-brown ferruginous oncolitic gravel-bearing sandy limestones interbedded with pebble-bearing sandy limestones.

Thin sections sampled from the middle part of the member reveal oncolitic limestone with admixture of sand and rare quartz pebbles. The clasts (3%) are medium-rounded, poorly sorted, 0.05 to 1.4 mm in diameter and consist of quartz and quartzite. Carbonate grains are: 1) oncoids of irregular shapes (15%), 0.1 to 1.5 mm, rarely up to 2.4 mm in diameter, and 2) fragments of bivalves, echinoderms and gastropods (10%). Calcite cement comprises 72% of the rock volume.

Paleontological characteristics:

The bulk of the fossils has been sampled from a condensed horizon 5–10 cm below the top of the member. These are: nautiloids *Cymatoceras* sp., *Xenocheilus ulixis* Shim.; ammonites *Protetragonites (?)* sp., *Neolissoceras grasianum* (d'Orb.), *Olcostephanus (Olcostephanus)* cf. *globosus* Spath, *Thurmanniceras* cf. *pertransiens* (Sayn), *Thurmanniceras* sp., *Belbekiceras belbekii* Baraboschkin, *Pseudacanthodiscus crymicus* Baraboschkin, *Ptychophylloceras ptychoicum* (Quenst.). The thickness of the member is 7.5 m.

The total thickness of oncolitic limestones in Sbrosovyi ravine is 12.5 m. Oncolitic limestones are overlain here by Hauterivian clays.

It is the first time that a large complex of ammonites from these deposits has been determined and described. *Belbekiceras belbekii* and *Pseudacanthodiscus crymicus* species are the new ones, their stratigraphical interval is not yet determined. *Neolissoceras grasianum* and *Olcostephanus (O.)* cf. *globosus* are known from the diapason of the whole Valanginian, *Ptychophylloceras ptychoicum* from the Berriasian and Valanginian. Only one species, *Thurmanniceras* cf. *pertransiens* occurs in the narrowest stratigraphical interval, which corresponds to the Lower Valanginian hypostratotype zone of the same name (Busnardo et al. 1979). On the base of these data, we consider the age of this oncolitic limestones to be the Early Valanginian. Of course, some additional material and analysis of the distribution of fossils in other sections are required to establish the boundary between Berriasian and Valanginian deposits in this region.

Hauterivian stage

Upper substage

Hauterivian sediments are preserved in the River Belbek Basin only in the small area: in Sbrosovyi ravine near Golubinka village. Here, dark grey clays, 20 m thick, unconformably overlie Lower Valanginian limestones. A great amount of aptychi *Lamellaptychus angulicostatus* (Pict. & Lor.), brachiopods *Cruralina belbekensis* Smirn., belemnites *Duvalia dilatata* (Bl.), *Pseudoduvalia polygonalis* (Bl.), crinoids *Phyllocrinus malbosianus* d'Orb., *Eugeniacrinites indens* Arendt, rarely young forms of ammonites *Phyllopachyceras* sp., shark teeth are met in the clays. This complex of fossils is characteristic for the lower zone of the Upper Hauterivian.

Upper Hauterivian clays are also found in the discussed region near the village of Vysokoe (River Kacha area). The following fossils have been found in these clays: belemnites *Duvalia dilatata* (Bl.), *D. binervioides* Verg., *Conobelus orbignyanus* Duval-Jouve.

The Lower and Upper Cretaceous

Upper substage of the Albian stage and lower substage of the Cenomanian stage (nondivided)

In the River Belbek Basin, sediments of this age are represented by green and light green fine- and medium-grained calcareous glauconitic sandstones containing magnetite grains. These sandstones transgressively overlie different-aged Lower Cretaceous rocks. In the basal part of the sandstones, small (up to 1 cm) well-rounded quartz pebbles occur. In the areas of the deepest erosion of underlying rocks (e.g. in the mouth of the Sukhoi ravine), the basal part of this unit is represented by a small-pebble conglomerate layer about 15–20 cm thick. In some areas, the sandstones contain lenses of grey and dark grey solid limestones crammed with shells of bivalves *Aucellina gryphaeoides* (Sow.).

Sandstones contain numerous fossils, among them aucellines are predominant. Other fossils are: ammonites *Anapuzosia naidini* Marc., *Puzosia mayoriana* (d'Orb.), *Desmoceras inane* (Stol.), *D. latidorsatum* (Mich.), *Mortoniceras rostratum* (J. Sow.), *M.* cf. *perinflatum* (Spath), *Hamites virgulatus* Brong., *Anisoceras perarmatum* Pict. & Camp., *Ostlingoceras puzosianum* (d'Orb.), *Mariella crassituberculata* Spath, *M. bergeri* (Brong.), *Lechites moreti* Breistr; belemnites *Neochibolites ultimus* (d'Orb.); gastropods *Metacerithium mosense* (Buvign.).

Complex of fossils mentioned above indicates the Late Albian age of deposits although some species – *Puzosia mayoriana* (d'Orb.) and *Neochibolites ultimatus* (d'Orb.) – occur in the Cenomanian, too. According to data presented by A. G. Kravtsov & A. I. Shalimov (1982), the sandstones contain also the ammonites *Puzosia planulata* (Sow.) and *Schloenbachia varians* (Sow.), which are typical for the Lower Cenomanian. No data about the boundary between the Upper Albian and the Lower Cenomanian in the River Belbek Basin have been obtained due to absence of complete sections of glauconitc sandstones.

Thickness of glauconite sandstones varies from 1.5 to 10 m.

The Upper Cretaceous

Upper Cretaceous sediments are widespread in the River Belbek Basin. They are more monotonous in comparison with the Lower Cretaceous ones (clayey-carbonate rocks prevail) (Text-fig. 3). Thus, the stratigraphic division of these deposits is difficult. On the basis of complexes of fossils, all stages of the Upper Cretaceous can be distinguished. Detailed characteristics of Cretaceous deposits of the River Belbek area has been given in Klikushin (1981, 1985).

Cenomanian stage and lower substage of Turonian age (nondivided)

The Cenomanian stage begins from the upper horizon of glauconite sandstones described above. These are conformably overlain by grey and dark grey marls and light grey clayey limestones. Several horizons of concretions and lenses of dark grey, sometimes almost black, brown, orange or bluish-grey cherts occur in the upper part of this unit. The thickness of this unit is 60–75 m.

Fossils are rare in these strata. The Cenomanian ammonites *Puzosia mayoriana* (d'Orb.), *Calycoceras (?)* sp., *Mantelliceras picteti* Hyatt, *Mesogaudryceras leptonema* (Sharpe) and bivalves *Inoceramus virgatus* Schl. and *Propeamussium ninae* (Karak.) have been found in the lower part of the unit. Early Turonian age of the upper part of these strata is proved by findings of *Inoceramus labiatus* Schl.ot. (Klikushin 1985) and *Mytiloides mytiloides* Mant.

Middle and upper substages of Turonian stage and Coniacian stage (nondivided)

Lower Turonian marlstones are overlain with an erosional contact by the strata of siliceous limestones. These are microcrystalline, solid, light-grey, almost white or slightly pinkish limestones, cut with numerous

stylolitic sutures. A horizon (1.0 m thick) of pinkish limestones filled with fragments of *Inoceramus'* shells is often observed in the middle part of this unit. The thickness of the siliceous limestones is up to 20 m.

The following fossils are typical for these strata: bivalves *Inoceramus apicalis* WOODS (Middle – Upper Turonian), *I. lusatiae* AND. (Upper Turonian – Lower Coniacian), *I. wandereri* AND. (Lower Coniacian), *I. websteri* MANT. (Lower Coniacian); ammonites *Tongoboryceras rhodanicum* (ROM. & MAZ.) (Upper Turonian), *Allocrioceras strangulatum* WRIGHT (Upper Turonian), *Scaphites geinitzii* (D'ORB.) (Upper Turonian); brachiopods *Orbirhynchia cuvieri* (D'ORB.) (Middle – Upper Turonian), *O. ventriplanata* (SCHL.) (Turonian – Coniacian), *O. dispansa* PETTITT (Turonian – Coniacian), *Najdinothyris becksii* (ROEM.) (Turonian – Coniacian); echinoids *Conulus subrotundus* (MANT.) *conoidea* POP.-BAR. (Middle – Upper Turonian), *Infulaster* sp.

The complex of fossils listed above indicates the Middle Turonian – Coniacian age of the siliceous limestones.

Santonian stage

In the River Belbek Basin, Coniacian deposits are overlain conformably or with an erosion by Santonian ones. The latter are represented by the strata of white and light grey chalk-like clayey limestones with thin (up to 1 cm) seams of greenish clays. The thickness of this unit is up to 40–50 m. Fossils are rare. Among them the bivalves *Inoceramus lesginensis* PAVL., *I. muelleri* PETR., the ammonites *Eupachydiscus* cf. *sayni* (DE GROSS.), the crinoids *Marsupites testudinarius* (SCHLOT.), *Uintacrinus socialis* GRINNEL and others, that indicate the Santonian age of the host deposits, have been determined.

Campanian stage and lower substage of the Maastrichtian stage (nondivided)

Deposits of this age are widely represented in the study area. They form well exposed sections in the White Range area, on the southern sides of "Danian" cuesta and Utyug mountain near Kuibyshevo, where they are represented by light grey and white clayey limestones and grey, light grey and light bluish-grey marls with thin (up to 1 cm) seams of dark greenish-grey siltstones, argilites and clays. The total thickness of this unit is up to 250 m.

Campanian age of the lower 200 m of these strata is proved by numerous findings of the ammonites *Neoglyptoxoceras retrorsum* (SCHLÜT.), *Parasolenoceras* cf. *phaleratum* GRIEP., *Desmophyllites diphylloides* (FORB.), *Bostrychoceras polyplocum* (ROEM.), *Gaudryceras kayei* (FORB.), *Eupachydiscus levyi* (DE GROSS.), *Pachydiscus haldemsis* (SCHLÜT.), the belemnites *Belemnitella langei* SCHATSKY, *B. conica conica* ARKH., *B. mucronata senior* NOW., the bivalves *Inoceramus balticus* BOEHM, *I. azerbaydjanensis* ALIEV, *I. harahini* MORTON, *I. convexus* HALL & MEEK, the echinoids *Micraster schroederi* STOLLEY. The crinoids *Austinocrinus rothpletzi* STOLLEY and shark's teeth have been found here as well.

The upper part of this unit (up to 50 m thick) contains fossils, which are typical for the upper part of the Campanian and the lower part of the Maastrichtian (bivalves *Inoceramus buguntaensis* DOBROV, *I. regularis* D'ORB. and typical Early Maastrichtian ammonites *Hauericeras sulcatum* (KNER), *Pseudokossmaticeras galicianum* (FAVRE), *Pachydiscus epiplectus* REDTENB. and belemnites *Belemnella lanceolata lanceolata* (SCHLOT.), *Belemnitella junior* NOWAK). The bivalves *Chlamys dujardini* ROEM., *Limatula decussata* (GOLDF.), *Entolium membranaceum* (NILSS.), the gastropods *Trochacanthus plicatocarinatus* (GOLDF.), *Avellana inversestriata* KNER, *Athleta bodrakiensis* BLANK, the crinoids *Bourgueticrinus aequalis* (D'ORB.), the sponges *Ventriculites* sp. have been determined as well. The ammonites *Diplomoceras cylindraceum* (DEFR.) and *Hoploscaphites constrictus* (SOW.) which are typical for the Maastrichtian in the whole have also been found in these strata.

Maastrichtian stage, upper substage

Upper Maastrichtian deposits are represented by bluish-grey silty marls and dark grey calcareous siltstones which are replaced upwards by greenish- and yellowish-grey fine-grained calcareous sandstones containing glauconite admixture in their upper part. The total thickness of these strata is up to 80 m.

Fossils indicating the Upper Maastrichtian age of this unit are less abundant and less diverse than those in the Lower Maastrichtian deposits. These are: ammonites *Pachydiscus neubergicus* (VON HAUER), *P. gollevillensis* (D'ORB.); bivalves *Spyridoceramus tegulatus* (HAGENOV), *Chlamys (Aequipecten) acuteplicatus* (ALTH), *Lopha*

semiplana (Sow.), *Exogyra auricularis* (Wahl.), *Pycnodonte (P.) mirabile* (Rouss.), *Pycnodonte (Phygraea) vesicularis* (Lam.); sponges *Spirospongia krymica* Kravtsov, and others.

The total thickness of Upper Cretaceous sediments in the River Belbek Basin reaches 480 m, the thickness of the whole Cretaceous sediments is 710 m.

Cretaceous sediments are overlain with an erosion by the strata of bryozoan and crinoidal limestones of Paleogene (Danian stage), which contain the following fossils: bivalves *Pycnodonte (Phygraea) similis* (Pusch), crinoids *Bourgueticrinus danicus* Nielsen, echinoids *Echinanthus pouechi* Cott.

Systematic descriptions

Order Ammonitida Hyatt, 1889

Suborder Phylloceratina Arkell, 1950

Superfamily Phylloceratacеae Zittel, 1884

Family Phylloceratidae Zittel, 1884

Subfamily Phylloceratinae Zittel, 1884

Genus *Phylloceras* Suess, 1866

Shell is strongly involute, with very narrow umbilicus. Whorl sections are high oval. Sculpture consists of very thin, dense lirae and more spaced coarse folds on flanks.

Jurassic – Cretaceous.

Subgenus *Neophylloceras* Shimizu, 1934

Whorl sections are high, compressed. Umbilicus is narrow. Shell bears radial or weakly flexuous lirae and radial costae, or not well designed broad folds. They are starting from the umbilical border. The costae disappear and do not reach the venter while lirae become coarser.

Albian – Maastrichtian.

Phylloceras (Neophylloceras) surya (Forbes, 1846)

Plate 12, fig. 8

1846 *Ammonites surya* Forbes, p. 106, pl. 7, fig. 10.
1959 *"Phyllopachyceras" surya* – Najdin, p. 176, pl. 15, fig. 3.
1992 *Phylloceras (Neophylloceras) surya* – Kennedy & Henderson, p. 391, pl. 1, figs. 1–7, 9, 13–14; pl. 15, figs. 4–5.
1993 *Phylloceras (Neophylloceras) surya* – Ward & Kennedy, p. 16, figs. 17.13, 18.3, 18.4, 18.16, 18.17 (with synonymy).
1993 *Hypophylloceras (Neophylloceras) surya* – Birkelund, p. 43, pl. 2, fig. 2 (with synonymy).

Shell strongly involute, umbilicus is less than 10 % of the diameter. Whorl section is high, oval. Umbilical slope is low, almost vertical. Umbilical border is rounded, but well-designed. Flanks are slightly convex, venter is narrowly rounded. The maximum thickness is somewhat below the middle of the flanks. Sculpture consists of numerous short and long costae occurring at intervals of 5 to 8 lirae and oriented parallel to them. The longer costae arise at umbilical border, while the shorter are intercalated on inner flank; all of equal strength on outer flank, but disappear at venter. Costae interspaces are two or three times wider than the costae. When the shell diameter is about 40 mm there are 20–24 costae per whorl, and when the diameter is about 80 – 100 mm their quantity arises more than four times. Lirae start from the umbilicus border and cover all the whorl surface uniformly. When the shell diameter is 80–100 mm there are about 200 lirae per whorl. The lirae are coarser in the ventral direction and cross the venter straightly.

Comparison: *Phylloceras (Neophylloceras) surya* (Forbes) differs from *Phylloceras (Neophylloceras) cottreaui* (Collignon) by the more narrow umbilicus, coarser costae and less width of the whorl.

Occurrence: Maastrichtian of Crimea, Caucasus, Denmark, South-West France, South India, South Africa, Australia, Chile, British Columbia.

Material: 6 specimens (1/12946, 1-4/12944, 25/12943).

Genus *Macrophylloceras* Spath, 1927

Shell is discoidal, involute with fine ribbing, becoming weaker near umbilicus. Thin ribs become obvious when the diameter is 5–6 cm.

Titonian – Berriasian.

Macrophylloceras ptychostoma (Benecke, 1865)

Plate 3, fig. 6

1865 *Ammonites ptychostoma* Benecke – in Oppel, p. 550.
1960 *Macrophylloceras ptychostoma* – Drushchits, p. 252, pl. 2, figs. 6a, b.

Whorls high, with gently convex flanks and narrow rounded venter. Umbilicus is narrow, cone-shaped. Ribbing of the flanks is dense, ribs are thin and cross the venter being inclined forward.

Comparison: This species differs from *M. heneckei* (Zitt.) by more thin and dense equally developed slightly curved ribs.

Occurrence: Titonian – Berriasian of Crimea and Germany.

Material: 1 specimen (21/330).

Subfamily Calliphylloceratinae Spath, 1927

Genus *Ptychophylloceras* Spath, 1927

Involute, smooth shell with narrow cone-shaped umbilicus. Venter broadly rounded. Peristome with two lateral lappets and weakly formed dorsal sinus. Umbilicus margin covered by some radial internal ridges, those in the nucleus correspond to the constrictions. Venter crossed by 3–8 labial ridges.

Jurassic (Upper Bathonian) – Cretaceous (Berriasian – Valanginian).

Ptychophylloceras ptychoicum (Quenstedt, 1845)

Plate 2, fig. 7; Plate 5, fig. 6

1845–1849 *Ammonites ptychoicus* Quenstedt, p. 219, pl. 17, fig. 12.
1868 *Phylloceras ptychoicum* – Zittel, p. 59, pl. 4, figs. 3–9.
1960 *Ptychophylloceras ptychoicum* – Drushchits, p. 250, pl. 1, figs. 1, 2a, b.

Involute, smooth shell with narrow cone-shaped umbilicus. Venter of the young whorls is broadly rounded, and on the adult ones it is more narrow. At 40 mm diameter on the venter and ventro-lateral shoulders there occur 5–6 labial ridges.

Comparison: Differs from *P. inordinatum* Toucas by the absence of ribs between ridges.

Occurrence: Berriasian – Valanginian of Crimea, West Europe, North Afrika.

Material: 3 specimens (15-16/330, 94/6).

Suborder Lytoceratina Hyatt, 1889

Superfamily Lytocerataceae Neumayr, 1875

Family Lytoceratidae Neumayr, 1875

Genus *Biasaloceras* Druzczic, 1953

Evolute shell with spheric or oval whorl section, slowly increasing, little overlappig or non-overlapping volutions. Ribs are simple radial, crossing straight the venter.

Lower Cretaceous (Berriasian – Barremian).

Biasaloceras liebigi (OPPEL, 1865)

Plate 2, fig. 4

1865 *Lytoceras liebigi* OPPEL, p. 74, pl. 9, figs. 5, 6; pl. 10.

Shell is evolute with oval whorl sectin and broadly rounded venter. Single non-obvious constriction can be seen. Ribs are very fine, dense, cross the venter.

Comparison: Differs from *B. subsequens* (KARAK.) by the oval whorl section.

Occurrence: Berriasian of Crimea.
Material: 1 specimen (11/330).

Superfamily Tetragonitaceae HYATT, 1900

Family Protetragonitidae SPATH, 1927

Genus *Protetragonites* HYATT, 1900

Shell is semievolute with flattened flanks. Whorl section varies from spherical to oval. Constrictions are seldom, accompanied by ridges and cross the venter straightly or with small curving. Sometimes shell is covered by fine grouth lines.

Berriasian – Aptian.

Protetragonites tauricus (KULJINSKAIA-VORONETZ, 1933)

Plate 2, fig. 5

1933 *Lytoceras (Protetragonites) quadrisulcatum* ORB. var. *taurica* KUL'SHINSKAYA-VORONETS, p. 21, pl. 2, figs. 9, 10, 14; pl. 6, fig. 7.
1960 *Protetragonites tauricus* – DRUSHCHITS, p. 259, pl. 6, figs. 4a, b; pl. 7, fig. 1.

Shell is semievolute with slowly increasing volutions. Whorl section is rounded rectangular, compressed when adult. Few constrictions (4 per the volution) are slightly curved forward on the venter.

Comparison: Differs from *P quadrisulcatus* ORB. by the more flattened shell, straight ridges with two constrictions on the backward and forward parts of the shell and ridges on the shell nucleus.

Occurrence: Berriasian of Crimea.
Material: 2 specimens (12-13/330).

Family Gaudryceratidae SPATH, 1927

Genus *Gaudryceras* DE GROSSOUVRE, 1894

Early whorls are evolute, depressed or compresses in section; later whorls compressed and expanding more rapidly than earlier ones. Sculpture consists of lirae or thin, often fine ribs, flexuosus, branched or not, which may coarsen and be bunched on later whorls. Constrictions are not deep.

Upper Albian – Maastrichtian.

Gaudryceras kayei (FORBES, 1846)

Plate 11, fig. 1

1846 *Ammonites kayei* FORBES, p. 101, pl. 8, fig. 3.
1979 *Vertebrites kayei* – KENNEDY & KLINGER, p. 160, pl. 14, fig. 2; text-fig. 5.
1992 *Gaudryceras kayei* – KENNEDY & HENDERSON, p. 402, pl. 5, figs. 19–20, 24, 28–41; text-fig. 3D.
1993 *Gaudryceras kayei* – WARD & KENNEDY, p. 17, figs. 17.11, 18.11, 18.12, 18.15.

Shell is evolute. Umbilicus is 45–60 % of the shell diameter. Early whorls are depressed, their thickness is 1.5 times more than their height. When the shell diameter is about 76 mm, the whorl height and thickness become equidimentional and venter becomes more narrow, but convex. Ornamentation is represented by thin sharp lirae with non-equal interspaces. On one whorl there occur up to 160 lirae arising from the umbilical seam. They are radial on the umbilical slope and prorsiradiate on the flanks, forming wide convexity bent forward on the venter. One whorl bears from 4 to 7 constrictions settled non-equidistantly.

Comparison: Differs from *Gaudryceras varicostatum* VAN HOEPEN by the variation of whorl width/whorl height ratio in the adult stage.

Occurrence: Upper Campanian of Crimea. Santonian of Tunis. Santonian – Campanian of South Africa and Mexico. Santonian – Maastrichtian of South India. Maastrichtian of Caucasus, Australia, Madagascar, Chile, California.

Material: 2 specimens (54/330, 5/12944).

Genus *Mesogaudryceras* SPATH, 1927

Shell is moderately evolute with compressed whorls from an early stage, showing a high egg-shaped section in the adult, with rather narrowly arched venter. Sculpture of lirae or fine ribs, sinuous and projected on the venter.

Lower and Middle Cenomanian.

Mesogaudryceras leptonema (SHARPE, 1855)

Plate 10, figs. 1–2

1855 *Ammonites leptonema* SHARPE, p. 32, pl. 14, fig. 3.
1959 *Gaudryceras sacya* var. – NAJDIN, p. 178, pl. 15, figs. 4–6.
1984 *Gaudryceras (Mesogaudryceras) leptonema* – WRIGHT & KENNEDY, p. 51, pl. 2, fig. 8; text-figs. 3A–M.
1987 *Mesogaudryceras leptonema* – THOMEL, p. 10, pl. 1, figs. 1, 5, 12; pl. 2, fig. 7; pl. 3, fig. 1; pl. 4, fig. 7; text-figs. 3, 4, 5.

Shell is moderately evolute. Early whorls (up to diameter 40 mm) are low, rounded. Subsequent whorls become high, compressed. Whorl section of the adult form is elongated oval with narrow rounded venter and flattened weakly convex flanks. Umbilical slope is almost vertical. Ribbing very thin (almost lirae) starting from umbilical seam. Near the umbilical margin ribs are bent backward, on the flanks they are flexuous, and on the venter they are directed forward. Young whorls bear up to 30 lirae per whorl, adult ones from 75 to 100. On one whorl there are from 6 to15 ribs.

Comparison: Differs from *Mesogaudryceras raricostatus* BALAN by the more dense ribbing.

Occurrence: Middle Cenomanian of Crimea, Kopetdag, Romania, Bavarian Alps, South-East France. Lower (?) or Middle Cenomanian of England and Greenland.

Material: 3 specimens (44-45/330, 1/12945).

Superfamily Haploceratacеae ZITTEL, 1884

Family Haploceratidae ZITTEL, 1884

Genus *Haploceras* ZITTEL, 1887

Shell is discoidal, semiinvolute, smooth with flattened flanks and wide from slightly to very convex venter. Peristome with a pair of lappets.

Kimmeridgian – Barremian.

Haploceras ex gr. *elimatum* (OPPEL, 1865)

Plate 2, fig. 6

Shell is semiinvolute, smooth with flattened flanks and wide weakly convex venter. The last whorl section is rectangular rounded, compressed. Umbilicus is moderately wide with abrupt umbilical wall.

Occurrence: Berriasian of Crimea.

Material: 1 specimen (14/330).

Genus *Neolissoceras* SPATH, 1923

Shell is of moderate size, from semiinvolute to involute, discoidal, smooth with rounded rectangular whorl section. Umbilicus is not deep, narrow. Umbilical slope inclined, low.

Upper Jurassic – Lower Cretaceous (Neocomian).

Neolissoceras grasianum (D'ORBIGNY, 1840)
Plate 5, fig. 7

1840 *Ammonites grasianus* D'ORBIGNY, p. 141, pl. 44.
1960 *Haploceras grasianum* – DRUSHCHITS, p. 268, pl. 13, fig. 6; text-fig. 73.
1977 *Neolissoceras grasianum* – FATMI, p. 263, pl. 1, figs. 1–2.
1987 *Haploceras (Neolissoceras) grasianum* – COMPANY, p. 97, pl. 2, figs. 1–9; pl. 18, fig. 1.

Shell is involute with rounded rectangular whorl section and strongly flattened flanks. Umbilicus is narrow and shallow. Umbilical slope slightly inclined, umbilicus border rounded with flanks.

Comparison: Differs from *Neolissoceras subgrasianum* (DRUZSCH.) by more involute shell and more convex venter.

Occurrence: Berriasian – Valanginian of Crimea, West Europe, North Africa, Madagascar, Central and South-East Asia.
Material: 1 specimen (94/7).

Superfamily Perisphinctaceae STEINMANN, 1890

Family Olcostephanidae HAUG, 1910

Subfamily Spiticeratinae SPATH, 1924

Genus *Spiticeras* UHLIG, 1903

Shell is semievolute or evolute with oval whorl section. About 2–5 ribs directed adorally arise from the umbilical tubercles, branched on the flanks and cross the venter. One volution bears from 2 to 4 sloping constrictions.

Titonian – Berriasian.

Spiticeras orientale (KILIAN, 1910)
Plate 3, fig. 2

1893 *Holcostephanus theodosia* – RETOWSKI, p. 45, pl. 1, fig. 19; pl. 2, fig. 1.
1960 *Spiticeras orientale* – DRUSHCHITS, p. 270, pl. 14, fig. 3.

Shell is evolute, inflated, open umbilicus and oval whorl section. Venter is narrowly rounded. One or two ribs branching in the middle of the flanks start from strong bullaes occurring near the umbilical shoulder (up to 20 per one whorl). Points of rib branching are accompanied by tubercles the most obvious on the early whorls. Secondary ribs have no tubercles. Ribs cross the venter without the reducing and with some bending adorally. One whorl bears one or two deep constrictions.

Comparison: Differs from *S. theodosia* DESH. by the more swelling whorls and coarse sculpture not reduced on the flanks.

Occurrence: Berriasian of Crimea, West Europe (France), Bulgaria, Hungary.
Material: 1 specimen (18/330).

Spiticeras obliquelobatum (UHLIG, 1903)
Plate 3, fig. 3

1903 *Holcostephanus (Spiticeras) obliquelobatus* UHLIG, p. 122, pl. 15, fig. 3.
1960 *Spiticeras obliquelobatum* – DRUSHCHITS, p. 269, pl. 14, fig. 1.

Shell is semievolute with moderately wide umbilicus, slightly convex flanks and narrow rounded venter. Bullaes are densely settled near the umbilical area. About 3–5 bad shaped biplicate ribs arise from these bullaes, increase at the venter and cross it without decreasing. Constrictions are deep, slightly bent foreward on the venter and accompanied by two labial ridges.

Comparison: Differs from *S. orientale* KIL. by the less coarse sculpture, the smaller elongated umbilical tubercles and thin ribs.

Occurrence: Berriasian of Crimea, India.
Material: 1 specimen (19/330).

Spiticeras multiforme DJANELIDZE, 1922
Plate 3, fig. 1

1922 *Spiticeras multiforme* DJANELIDZE, p. 143, pl. 7, fig. 3; pl. 15, figs. 1, 2; pl. 20, fig. 1; pl. 22, fig. 3.

Shell is semievolute with broadly convex venter. Umbilical tubercles are small, dense. Bundles of biplicate ribs (3–5 ribs in bundle) weakly elevated at the umbilicus and well shaped at the venter start from these tubercles. Ribs cross the venter with some bent foreward. One whorl bears 4 deep constrictions settled obliquely toward the ribbing.

Comparison: Differs from *S. bilobatum* UHL. by the narrower umbilicus, higher and vertical umbilical walls, more inflated whorl and numerous umbilical tubercles.

Occurrence: Berriasian of Crimea.
Material: 1 specimen (17/330).

Subfamily Olcostephaninae HAUG, 1910

Genus *Olcostephanus* NEUMAYR, 1875

Subgenus *Olcostephanus* NEUMAYR, 1875

Shell is semiinvolute, from middle-sized to large, with low and broadly rounded whorl section. Umbilicus is moderately narrow, deep, with high abrupt umbilical wall. Sculpture is represented by tri-eightplicated ribs branching on the umbilical shoulder to form elongated tubercles (bullaes) and by the constrictions. Ribs cross venter without weakening.

Valanginian – Hautcrivian.

Olcostephanus (Olcostephanus) cf. *globosus* SPATH, 1939
Plate 5, fig. 5

Middle-sized shell. Whorl section is eliptical, its width is twice more than its height. Umbilicus is moderately narrow, deep with abrupt high umbilical wall. Sculpture consists of five-sixplicated thin ribs starting from the elongated umbilical tubercles (bullaes) inclined in adoral direction (up to 10 per one whorl). Ribs lean slightly backward. On the only internal mould (being in our collection) there is preserved peristome with the high collar and preceding constriction.

Comparison: This specimen due to ornamentation and involution is very close to holotype of *Olcostephanus globosus*, described by L. SPATH (SPATH 1939, pl. 5, figs. 3a, b) and discussed by G. AUTRAN (AUTRAN 1989, p. 35) as a macroconch of this species. From this point of view our specimen is a microconch.

Occurrence: Valanginian of Crimea, West Europe, Pakistan.
Material: 1 specimen (94/5).

Family Neocomitidae SALFELD, 1921

Subfamily Berriasellinae SPATH, 1922

Genus *Dalmasiceras* DJANELIDZE, 1922

Shell is discoidal. Whorl section is highly oval with flanks flat-parallel or slightly converging to the periphery. Venter shape varies from flattened to rounded. Ribs are thin, dense on the early whorls, on the later ones they are bundled starting from umbilical tubercles. Ribs become smoother on the flanks and coarser on the venter. Sometimes ribs branch again near the lateral tubercles. Body chamber with the lappets.

Upper Titonian – Berriasian.

Dalmasiceras crassicostatum (DJANELIDZE, 1922)
Plate 1, figs. 1–3

1922 *Hoplites (Dalmasiceras) crassicostatum* DJANELIDZE, p. 273, pl. 13, fig. 4a, b.
1960 *Dalmasiceras crassicostatum* – DRUSHCHITS, p. 281, pl. 25, figs. 2, 3a, b.

Shell is discoidal with the flattened flanks converging to the peripherie. Whorl section is high trapezium with flattened venter. Umbilicus is relatively wide with abrupt umbilical wall. Flanks costated with thin ribs starting from near-umbilical tubercles and branching on the middle of flanks with bend foreward. Secondary ribs also occur. Ribs are smoothed out on the flanks and strengthened near the venter; on the middle of the venter they are interrupted to form groove. Ribs were smoothed out with the age. Ribs of some specimens identified as *Dalmasiceras* aff. *crassicostatum* (DJANELIDZE) (Plate 1, figs. 4–5; Plate 2, figs. 1–2) start from the tubercles bundling in pairs and bifurcate on the middle of the flanks. On the venter ribs are smoothed out but not interrupted. Number of near-umbilical tubercles on the last whorl is about 20–23; they are small, rounded.

Comparison: Differs from *D. dalmasi* PICT. by the enlarged size and coarser sculpture.

Occurrence: Berriasian of Crimea and France.
Material: 9 specimens (1–9/330).

Dalmasiceras sp.
Plate 2, fig. 3

Specimen differs from all known species of genus *Dalmasiceras* by large elongated far apart from each other near-umbilical tubercles (up to 15 on the last whorl of the shell).The pair of ribs starts from every tubercle, every rib bifurcate on the middle of the flanks.

Occurrence: Berriasian of Crimea.
Material: 1 specimen (10/330).

Genus *Neocosmoceras* BLANCHET, 1922

Shell is from middle-sized to large with subrectangular or oval whorl section. Ribs are coarse, widely spaced, with three rows of tubercles, often branched at lateral ones, interrupted on the venter. Ventral tubercles are the most developed ones; on the body chamber of some species they transform into inclined backward spines.

Berriasian.

Neocosmoceras sp.
Plate 4, fig. 6

1939 *?Neocosmoceras* n. sp. indet. – MAZENOT, p. 188, pl. 31, fig. 8a, b.

The only fragment of the body chamber is preserved. Based on its size the shell was very large (whorl height is 59 mm, whorl width 43 mm, umbilicus diameter 92 mm). Whorl section is rectangular – oval. Flanks are sightly convex, ventral bending is smooth, but well-defined. Venter is narrow, convex. Umbilicus is wide with low, inclined walls and smooth umbilical shoulder. Sculpture consists of rare coarse radial ribs bearing three rows of tubercles – umbilical, lateral and ventral ones. The lateral and ventral tubercles are the most developed. Ribs cross the venter straightly. More thin secondary ribs appear in some cases on the middle of flanks between primary ribs.

Comparison: The shell dimensions are larger than ones of any known *Neocosmoceras* species and due to whorl section shape, rough ribs bearing three rows of tubercles it is similar to specimen described by MAZENOT (MAZENOT 1939, pl. 31, fig. 8), but differs from it by the absence of primary rib branching at the lateral tubercles.

Occurrence: Berriasian of Crimea.
Material: 1 specimen (24/330).

Genus *Euthymiceras* GRIGORIEVA, 1938

Shell is semievolute, consists of slowly increasing whorls with rectangular or rectangular-oval whorl sections. Three rows of tubercles: near-umbilical, lateral, and tubercles of ventral shoulder. Coarse ribs bifurcate at the lateral tubercles and cross the venter either with weakening or without it.

Berriasian.

Euthymiceras (?) ex gr. *euthymi* (PICTET, 1867)

Plate 4, figs. 2–5

Small shells with moderately low and moderately increasing whorls of medium width. Flanks are slightly convex, venter is narrow, flat. Whorl section in general is trapezoidal. Umbilicus is moderately wide with low inclining slope. Sculpture consists of strong biplicate and simple primary ribs and secondary ribs and near-ventral tubercles. Primary ribs start from the umbilical slope and become stronger on the umbilical shoulder to form ridges. In the lower third or in the middle of the flanks some ribs branch in pairs. In the branching point they also form a ridge, or very rare a tubercle. Secondary ribs start from the different parts of the flanks. In the upper part of the flanks ribs form some bend forward and are ended on the ventral shoulder by the formation of distinct sharp tubercle. Near ventral tubercles appear on the early whorls and are very distinct on the whorls with a diameter less than 10 mm. Lateral tubercles occur seldomly. Venter of the young whorls is smooth between those tubercles, the later whorls sometimes bear reduced ribs or ridges crossing the venter straightly.

Comparison: Described species differs from species *E. euthymi* (PICTET) (1867, p. 76, pl. XIII, fig. 3) by narrower umbilicus and presence of only one row of distinctive, near-ventral tubercles.

Occurrence: Berriasian of Crimea.
Material: 14 specimens (23/330, 1–13/12943).

Genus *Malbosiceras* GRIGORIEVA, 1938

Shell with slowly increasing whorls and flattened flanks and relatively wide venter. Coarse ribs with two rows of large umbilical and lateral tubercles. Lateral tubercles give rise to bundle containing two or three ribs. Two or three secondary ribs without tubercles are settled between these bundles.

Berriasian.

Malbosiceras (?) sp.

Plate 3, figs. 4–5

Shell is very large. Whorls weakly increased, slightly compressed. Venter wide, flattened. Flanks are flat or slightly convex. Umbilical slope low, inclined . Whorl section almost rectangular or slightly trapezoid. On the young whorls (D = 60–70 mm) ribs are dense, rather thin. Ribs are single, dichotomic with the branching on the middle of the flanks and triplicate with two branchings – near the umbilical shoulder (or somewhat higher) and on the middle of the flanks. Umbilical and lateral nodes appear on the whorls with a diameter more than 100 mm. On the branched ribs nodes are settled on the points of branching. With age simple ribs starting from the umbilical shoulder are gradually disappearing, being substituted by short intercalatory ribs (up to 3–4 between two dichotomic ones). Adult whorls bear both long and short ribs, but with age long ones are disappearing and the only short ribs remain. On the body chamber short ribs are absent. Body chamber bears widely spaced pair of long simple ribs and one dichotomic rib. Ribs cross the venter being widely bent forward and without interruption (on the shell nucleus ribs are slightly reduced on the venter middle).

Comparison: Bad safety of specimens does not allow to make the precise genus definition. Differs from genus *Mazenoticeras* NIKOLOV, 1966 by the later appearance of nodes and by short intercalatory ribs.

Occurrence: Berriasian of Crimea.
Material: 7 specimens (20/330, 14–19/12943).

Subfamily Neocomitinae SALFELD, 1921

Genus *Thurmanniceras* COSSMANN, 1901

Shell is from semievolute to semiinvolute with trapezoid or rounded trapezoid whorl section. Umbilicus is moderately narrow to deep, with abrupt narrow umbilical wall. Sharp umbilical border. Cyclic sculpture consists of simple, two-sixplicated and branched ribs, and rib bundles thickened in the branching points. Whorl bears some constrictions. Ribs are ended on the ventral bend to form almost right angle with shell plane of symmetry and without crossing the venter.

Lower Valanginian.

Thurmanniceras cf. *pertransiens* (SAYN, 1907)

Plate 5, figs. 3–4

Middle-sized, rarely large semiinvolute shell with subrectangular and slightly convex flanks or rectangular whorl section. Umbilicus is moderately narrow, not deep with narrow vertical umbilical wall and sharp umbilical shoulder. Cyclic sculpture consists of single, two-fourplicated, branched ribs and rib bundles, as well as constrictions. Constrictions are narrow, falcoid dividing cycles of ribs. Simple ribs are also falcoid and occur (one or two) in the beginning of the cycles of ribs on young and middle age whorls (up to D = 20–30 mm). Biplicated and branched ribs occur in the middle of the cycles (1–2 ribs per cycle). They are branched at the upper part of the flanks without node formation. Three-fourplicate ribs branch in the middle of flanks and occur both in the cycle middle and end. All described types of ribs are united into the bundles with the bundle primaries conjuncted on the umbilical shoulder. Bundles are prevailing in the end of cycles of ribs on the middle whorls (D = 20–30 mm) and cover whole cycles on the adult whorls (up to D = 80–90 mm). All ribs are ended on the ventral shoulder with formation of small tubercles settled down at the angle of 75–90° to plane of shell symmetry. The venter is flattened, slightly convex on young whorls. Ribbing of the later whorls (diameter more than 90–100 mm) is smoothed almost completely.

Comparison: Kind of sculpture, deep constrictions, and involution of shell make these specimens to be similar to those of *Thurmanniceras pertransiens valdrumensis* (SAYN, 1907), but fragmentary material does not allow to give more precise identification.

Occurrence: Lower Valanginian, Thurmanniceras pertransiens Zone of Crimea, West Europe, North America.
Material: 2 specimens (94/2 – 94/3).

Thurmanniceras sp.

Plate 5, fig. 2

The fragment of phragmocone of large semiinvolute shell with wide trapezoid whorl section. Preserved cyclic sculpture is characteristic for all genus and consists of branched ribs, rib bundles, and constrictions. Weakly falcoid ribs branch in the upper third of the flanks and couple into the bundles on the umbilical shoulder. Boundles consist of two primary and five secondary ribs. Ribs are ended on the venter with formation of small tubercle having angle 70° to plane of shell symmetry. Venter is slightly convex. Constriction dividing rib bundles is narrow and shallow.

Comparison: This specimen differs from *Thurmanniceras pertransiens* (SAYN) by the low wide whorl section; from the other representatives of this genus by the constrictions on the large whorls.

Occurrence: Lower Valanginian, Thurmanniceras pertransiens Zone of Crimea.
Material: 1 specimen (94/4).

Genus *Belbekiceras* BARABOSCHKIN 1997

Shell of middle size, semievolute with sixangular or rounded sixangular compressed whorl section. Wide, shallow umbilicus with narrow umbilical wall. Sculpture is represented by simple, bi- or rarely triplicate ribs branched on the umbilical border and in the upper third of flanks. Points of branching and the ventral shoulder bear small sharpened nodes. Ribs do not cross the venter and are united into the cycles divided by shallow constrictions.

Specific composition: *Belbekiceras belbekii* BARABOSCHKIN 1997.

Comparison: Young whorls of genus are similar to ones of Berriasian *Euthymiceras* and *Transcaspiites*, but differ from them by the other type of cycles of ribs and ornaments of the adult whorls, which are close to those of Valanginian *Busnardoites* and *Calliptychoceras*. From the latter this genus differs by the sculpture of middle whorls and synclinal settling of ventral nodes toward the plane of shell symmetry.

Lower Valanginian of Crimea.

Belbekiceras belbekii BARABOSCHKIN, 1997

Plate 5, fig. 1

1997 *Belbekiceras belbekii* BARABOSCHKIN – in ARKADIEV, ATABEKIAN, BARABOSCHKIN et al., p. 117, pl. 37, fig. 1.

Holotype (figured in this paper): Pl. 5, fig. 1, N 94/1, Moscow State University Museum of Physical Geography.
Type locality: Crimea, Belbek River, Sbrosovyi ravine.
Type level: The Lower Valanginian, Thurmanniceras pertransiens Zone.

Shell with high sixangular (up to rounded sixangular) whorl section and flattened flanks. Wide, shallow umbilicus with low umbilical wall fluently transforming into lateral sides. Cyclic sculpture is represented by simple, bi- and triplicate ribs and weak constrictions dividing the cycles. Simple falcoid ribs slightly bent toward the aperture, thickest in the upper third of flanks. These ribs are settled in the beginning (after the constriction) and in the middle of the cycle mainly on the middle whorls. Biplicate ribs generally occur near the cycle end, and on the middle whorls they branch in the upper third of the flanks to form small sharpened nodes. On the contrary, the ribs completing the cycle branch on the umbilical shoulder with the formation of small swelling. This very type of biplicate ribs remains on the later whorls accompanied by triplicate ribs branched not only on umbilical shoulder, but also on the upper third of the flanks. All ribs do not cross the venter and are ended on the ventral shoulder with equidimensional slightly flattened tubercles settled at the angle of 45° to plane of shell symmetry. Half of the whorl bears up to three cycles containing four simple and two or three biplicate ribs.

Occurrence: Lower Valanginian of Crimea.
Material: 1 specimen (94/1).

Genus *Pseudacanthodiscus* Baraboschkin, 1997

Large semievolute shell with eight-angular whorl section. Moderately narrow umbilicus with abrupt umbilical wall. Sculpture consists of simple, biplicate and branched ribs. Young whorls bear constrictions. Biplicate ribs branch on the upper third of flanks with big blunt tubercles on the points of branching and on the umbilical shoulder. Ribs do not cross the venter ending on the ventral shoulder by the low flat tubercles settled at the obtuse angle to the plane of shell symmetry.

Specific composition: *Pseudacanthodiscus crymicus* Baraboschkin, 1997, *P. subradiatum* (Uhlig, 1910).

Comparison: This genus is very similar to Early Hauterivian genus *Acanthodiscus* and recently has been identified to it (Nikolov, 1960), but differs from the latter by more coarse sculpture of the young whorls bearing constrictions and by the obtuse angle of settling of dorsal tubercles and coarse ribs on large whorls.

Lower Valanginian of Crimea, Valanginian of the Himalayas and Balkan (?) Mountains.

Pseudacanthodiscus crymicus Baraboschkin, 1997

Plate 5, figs. 8–9

1997 *Pseudacanthodiscus crymicus* Baraboschkin – in Arkadiev, Atabekian, Baraboschkin et al., p. 118, pl. 38, figs. 1–2.

Holotype (figured in this paper): Pl. 5, fig. 8, N 94/8, Moscow State University Museum of Physical Geography.
Type locality: Crimea, Belbek River, Sbrosovyi ravine.
Type level: The Lower Valanginian, Thurmanniceras pertransiens Zone.

Shell with eightangular whorl section compressed at the later whorls. Moderately wide, not deep umbilicus with abrupt (up to vertical) high umbilical wall, fluently transforming into the flanks. Cyclic sculpture consists of simple, biplicate and branched ribs and constrictions. Branched ribs are coarse with branching on the upper third of flanks. Branches are short, straight, bent forward. Branching points and umbilical shoulder bear elongated large blut flattened tubercle. All ribs are ended on the ventral shoulder by the low tubercles with flattened sides. These tubercles are settled at the angles 75–80° to the plane of shell symmetry. On the young whorls (D = 20–30 mm) cycles of ribs consist of one or two simple ribs (cycle beginning) and 3–4 biplicate and branched ribs. Cycles are divided by narrow, not deep constrictions. On the middle whorls (D = 30–60 mm) cycles are divided by wide shallow constrictions and consist of two pairs of biplicate and branched ribs and one simple rib between them. On the later whorls (diameter more than 60–70 mm) ribbing is represented by the interchanging simple and branched ribs without lateral tubercles.

Comparison: Differs from *Pseudacanthodiscus subradiatum* (Uhlig) by the simple ribs and wide constrictions on the middle whorls and less angle of settling of ventral tubercles.

Occurrence: Lower Valanginian of Crimea.
Material: 2 specimens (94/8 – 94/9).

Superfamily Desmoceratacеae Zittel, 1895

Family Desmoceratidae Zittel, 1895

Subfamily Puzosiinae Spath, 1922

Genus *Anapuzosia* Matsumoto, 1954

Large or middle-sized discoidal, moderately involute shell. On the early and middle stages of growth sculpture consists of coarse, curved primary ribs starting from the umbilical border and crossing the venter with the bend forward. Adoral side of the primary ribs is accompanied by the constrictions. Interspaces are covered by numerous thin secondary ribs starting above the umbilical border and directed along the primary ones. Many of secondaries branch on the upper part of flanks. Secondaries and constrictions disappear on the last whorl, while the primaries become coarser and more numerous.

Albian – Cenomanian (?).

Anapuzosia naidini Marcinowski, 1977

Plate 6, fig. 5

1977 *Puzosia (Anapuzosia) naidini* Marcinowski, p. 41, pl. 1, text-figs. 1–2.

Shell large. Belbck spccimen of this species with the diameter 140 mm is represented by nucleus of phragmoconc and fragment of body chamber. Body chamber of the holotype covers more than half of the last whorl. Shell with high oval phragmoconc whorl section, slightly convex flanks and narrow rounded venter. Umbilicus (U/D = 30–39 %) with low umbilical wall fluently transforming into the flanks. High body chamber with almost parallel flanks and wide venter. On this stage of growth umbilical wall becomes vertical abruptly transforming into flanks.

Sculpture safety of the Belbckian spccimcn is not satisfactory. On the holotype it is represented by the primaries with constrictions and secondary branched ribs (8–14 between every pair of primaries). Primaries arise from the umbilical shoulder, secondaries on the lower parts of flanks. All ribs cross the venter being bending forward. Body chamber bears the only primaries, constrictions and secondaries are absent.

Comparison: Differs from *Anapuzosia grandis* Marc. by the highly increasing dimensions of the body chamber whorl having almost parallel flanks and flat venter as well as wider umbilicus.

Occurrence: Upper Albian (upper part) of Crimea.
Material: 1 specimen (30/330).

Genus *Puzosia* Bayle, 1878

Large and middle-sized evolute shell with oval whorl section, slightly convex flanks and rounded venter. Not deep, moderately wide umbilicus with clear umbilical shoulder. Deep constrictions crescent-shaped on the flanks are strongly bent forward on the venter. Thin, simple ribs. Ribbing on the body chamber is weak or absent at all.

Albian – Turonian, sometimes Coniacian.

Puzosia mayoriana (d'Orbigny, 1841)

Plate 6, figs. 1–4

1827 *Ammonites planulatus* – J. de C. Sowerby, p. 134, pl. 570, fig. 5 (non Schlotheim, 1820, p. 59).
1841 *Ammonites mayorianus* d'Orbigny, p. 267, pl. 79, figs. 1–3.
1984 *Puzosia (Puzosia) mayoriana* – Wright & Kennedy, p. 55, pl. 3, figs. 1, 2, 4, 6, 9 – 12; pl. 4, figs. 1, 2, 5–7; text-figs. 1A, B, 2C, H, M, 3N–R, 4A–E.
1987 *Puzosia (Puzosia) mayoriana* – Cooper & Kennedy, p. 106, figs. 1–7, 9–10.
1990 *Puzosia mayoriana mayoriana* – Marcinowski & Wiedmann, p. 55, pl. 5, fig. 5.

All Belbekian specimens are microconchs with sizes about 40 – 60 mm. Shells are moderately involute. Not deep umbilicus with abrupt umbilical wall and rounded umbilical shoulder. Slightly convex flanks, narrow rounded venter. One whorl bears 5–8 constrictions. From 8 to 15 thin simple ribs are settled in the interconstriction spaces on the upper parts of the whorls and cross the venter with the appreciable bend forward.

Macroconchs of large diameters (about 150–200 mm) are evolute with high rounded rectangular whorl section. One whorl bears from 4 to 6 constrictions with 18–32 thin sigmoid ribs settled down between every pair of constrictions. Ribs of macroconch as well as microconch ribs cover only the upper parts of the whorls. Constrictions are deeper and winding, almost crescent.

Comparison: Differs from *P. subcorbarica* MATS. by more winding constrictions and ribs as well as more globular whorls.

Occurrence: Upper Albian, Lower and lower part of Middle Cenomanian of Crimea; Upper Albian – Cenomanian of Caucasus, Mangyshlak, Europe, Africa, South India, New Guinea.

Material: 12 specimens (25–29/330, 6–12/12944).

Subfamily Desmoceratinae ZITTEL, 1895

Genus *Desmoceras* ZITTEL, 1884

Involute globular shell with low subsquare or suboval whorl section. Sculpture is represented by sigmoid ribs, with corresponding constrictions on the internal mould between which are dense weak ribs on the outer part of the flanks and venter. Some species have almost smooth shell. Characteristic feature of genus is the presence of dense and very thin striae.

Upper Aptian – Turonian.

Desmoceras inane (STOLICZKA, 1865)

Plate 9, fig. 2

1865 *Ammonites inanis* STOLICZKA, p. 121, pl. 59, fig. 13.
1958 *Desmoceras (Latidorsella) inane* – ANDERSON, p. 215, pl. 10, fig. 3.

Not large, strongly involute shell with very narrow deep umbilicus and oval whorl section with narrow venter. The maximum width occurs near umbilical shoulder and equal to whorl height. Vertical umbilical wall with abrupt umbilical shoulder. The early whorls are smooth. When the shell reaches the diameter 25 mm the rare constrictions occur, but Belbekian specimens do not have these sculptures due to bad safety. Constrictions are concave on the flanks and bent forward on the venter.

Comparison: Differs from *Desmoceras latidorsatum* (MICHELIN) by the narrower umbilicus and narrower venter.

Occurrence: Upper Albian (upper part) of Crimea; Upper Albian – Cenomanian (?) of South India, South Africa and California.

Material: 1 specimen (42/330).

Desmoceras latidorsatum (MICHELIN, 1838)

Plate 9, figs. 3–5

1838 *Ammonites latidorsatus* MICHELIN, p. 101, pl. 12, fig. 9.
1984 *Desmoceras (Desmoceras) latidorsatum* – WRIGHT & KENNEDY, p. 61, pl. 3, figs. 3, 5, 7, 8, 13; text-figs. 2B, I.
1990 *Desmoceras (Desmoceras) latidorsatum* – MARCINOWSKI & WIEDMANN, p. 62, pl. 7, figs. 2–3 (with synonymy).

Involute shell with narrow umbilicus. Abrupt, low umbilical wall. Globular whorls with different whorl sections. Some specimens have compressed whorl section, some of them depressed. Venter of all specimens is wide, slightly convex. Some specimens have constrictions and thin ribs (8 – 15 ribs between every pair of constrictions). Constrictions usually falcate.

Comparison: Differs from *Desmoceras inane* (STOLICZKA) by the wider umbilicus and wide venter.

Occurrence: Upper Albian (upper part) of Crimea; Middle Albian – Upper Cenomanian of almost all the world.

Material: 3 specimens (43/330, 2–3/12945).

Genus *Desmophyllites* Spath, 1929

Not large strongly involute shell with high or low oval or elipsoidal whorl section. Convex rounded venter. Falcoid constrictions are strongly bent forward and elevated on the venter. Shell is smooth or covered by thin growth lines.

Santonian – Maastrichtian.

Desmophyllites diphylloides (Forbes, 1846)

Plate 12, fig. 1

1846 *Ammonites diphylloides* Forbes, p. 105, pl. 8, fig. 8.
1992 *Desmophyllites diphylloides* – Kennedy & Henderson, p. 405, pl. 6, figs. 1–9; pl. 16, figs. 1–3, 7–8; pl. 17, figs. 4–7; text-fig. 3F.
1993a *Desmophyllites diphylloides* – Kennedy & Cobban, p. 120, pl. 1, figs. 1–8; text-fig. 5C.

Shell with almost closed umbilicus. Vertical umbilical wall with clear rounded umbilical shoulder. Slightly convex flanks. Wide, convex venter. One whorl bears 6–10 sinusoidal constrictions bent forward on the venter.

Comparison: Differs from *Desmophyllites larteti* (Seunes) by lower and wider whorl sections and more narrow umbilicus.

Occurrence: Upper Campanian of Crimea; Campanian of southern Sakhalin; Santonian – Maastrichtian of South India, Australia, Japan, Africa, France, Alaska, British Columbia, California, Argentina; Maastrichtian of United Arab Emirates.

Material: 1 specimen (57/330).

Subfamily Hauericeratinae Matsumoto, 1938

Genus *Hauericeras* de Grossouvre, 1894

Discoidal evolute shell with narrow high whorls. Very low vertical umbilical wall. Flattened or slightly convex flanks. Sharp venter bears keel. Usually shell is smooth, but some species have small tubercles or ribs on the upper parts of flanks. Well-shaped sinusoidal constrictions. Dimorphism is characteristic for this genus: both microconchs and macroconchs occur.

Coniacian – Maastrichtian.

Hauericeras fayoli de Grossouvre, 1894

Plate 12, fig. 6

1894 *Hauericeras fayoli* de Grossouvre, p. 220 pars, pl. 27, fig. 3.
1959 *Hauericeras fayoli* – Najdin, p. 191, pl. 16, fig. 3.
1993 *Hauericeras fayoli* – Hancock & Kennedy, p. 155, pl. 1, figs. 1, 2.

Strongly evolute shell. Umbilicus width is 45 – 48% of shell diameter. Lanceolate whorl section. Low and vertical umbilical wall. Umbilical shoulder sharp. Flattened inner and convergent outer flanks. Acute venter with the low keel. From 4 to 5 strongly simusoidal constrictions per one whorl are becoming weaker with the shell increasing.

Comparison: Differs from *Hauericeras sulcatum* (Kner) by more evolute shell, lower whorls bearing less numbers of constrictions.

Occurrence: Uppermost Campanian of Crimea; Uppermost Campanian or Lowermost Maastrichtian of South France; Upper Campanian of Austria, Slovakia, Bulgaria, Hungary; Lower Maastrichtian (?) of Madagascar.

Material: 1 specimen (20/12943).

Hauericeras sulcatum (Kner, 1848)

Plate 12, fig. 7

1848 *Ammonites sulcatus* Kner, p. 8, pl. 1, fig. 3.
1951 *Hauericeras sulcatum* – Mikhaylov, p. 79, pl. 11, fig. 49; pl. 12, fig. 51.
1959 *Hauericeras sulcatum* – Najdin, p. 190, pl. 14, figs. 1, 2.
1987 *Hauericeras sulcatum* – Kennedy & Summesberger, p. 27, pl. 1, figs. 1–7; pl. 13, fig. 2.

Flattened evolute shell. Umbilicus width is about 37–39 % of shell diameter. High acute whorl section. Very narrow, vertical umbilical wall with sharply rounded umbilical shoulder. Flattened flanks. Venter is very narrow, acute with high keel. One whorl usually bears 7–8 indistinct constrictions of fluently curved shape.

Comparison: Differs from *Hauericeras fayoli* DE GROSSOUVRE by more narrow umbilicus, higher and more flattened whorl section, and larger number of constrictions per one whorl as well as by the characteristic concavity of the constrictions.

Occurrence: Lower Maastrichtian of Crimea, Caucasus, Kopetdag, West Ukraine, Poland Bulgaria, Alps.
Material: 5 specimens (60/330, 55/8304, 4–5/12945, 13/12944).

Family Kossmaticeratidae SPATH, 1922

Subfamily Kossmaticeratinae SPATH, 1922

Genus *Pseudokossmaticeras* SPATH, 1922

Evolute shell with high oval or up to round whorl section. Skulptur consists of primary and secondary ribs crossing the venter without interruption as well as weak umbilical tubercles and sometimes constrictions.

Upper part of Upper Campanian (?) – Maastrichtian.

Pseudokossmaticeras galicianum (FAVRE, 1869)

Plate 15, figs. 2–4

1869 *Ammonites galicianus* FAVRE, p. 16, pl. 3, figs. 5, 6.
1951 *Pseudokossmaticeras* cf. *galicianum* – MIKHAILOV, p. 78, pl. 7, fig. 38.
1970 *Pseudokossmaticeras* cf. *galicianum* – ATABEKIAN & HAKOBIAN, p. 36, pl. 1, fig. 4.
1991 *Pseudokossmaticeras galicianum* – KENNEDY & SUMMESBERGER, p. 94, pl. 1, figs. 1–6.
1993 *Pseudokossmaticeras tercense* – HANCOCK & KENNEDY, p. 157 (part), pl. 8, figs. 1–6.
1993b *Pseudokossmaticeras galicianum* – KENNEDY & COBBAN, p. 411, fig. 5, 21.

Evolute shell. Umbilicus width is about 37–38 % of shell diameter. Oval whorl section with the height larger than its width. Rarely height is almost equal to width. Umbilical wall is smooth, almost vertical with abrupt but rounded umbilical border. Slightly convex flanks convergent to rounded venter. Small sharpened tubercles are settled on the umbilical border. Simple, rarely biplicate primaries start from these tubercles. Space between primary ribs sometimes is covered by secondaries. Latter can arise at the different parts of the flanks. So, near the umbilical shoulder there are counted 20–24 ribs and at the venter about 40–50 ones. Ribs cross the venter without weakening. Umbilical tubercle dimensions, size of ribs and width of interspaces are increasing on the body chamber. Sometimes very weak non-equidistant constrictions occur.

Comparison: Differs from *Pseudokossmaticeras tercense* (SEUNES) by the ribbing (absence of triplicate ribs).

Occurrence: Lower Maastrichtian of Crimea, Caucasus, Kopetdag, West Ukraine, Poland, Bulgaria, Alps, South-West France and North America.
Material: 5 specimens (68/330, 14–15/12944, 6/12945, 2/12946).

Family Pachydiscidae SPATH, 1922

Genus *Tongoboryceras* HOUSA, 1967

Shell not large, moderately involute, globular, with low wide rounded whorl section. Young whorls bear the only deep constrictions strongly bent forward on the venter. Subsequent whorls are covered by constrictions and thick strong flexuous ribs (primaries and secondaries), sometimes biplicated. Primaries arise from the umbilical shoulder sometimes bearing very weak, hardly visible umbilical bullae.

Turonian – Coniacian.

Tongoboryceras rhodanicum (ROMAN & MAZERAN, 1913)

Plate 10, figs. 8–11

1913 *Pachydiscus rhodanicus* ROMAN & MAZERAN, p. 18, pl. 1, figs. 10a, 10b.
1979 *Tongoboryceras rhodanicum* – WRIGHT, p. 316, pl. 6, figs. 1, 7.
1987 *Tongoboryceras* cf. *rhodanicum* – IMMEL, p. 93, pl. 9, fig. 6.

Shell subglobular, involute. Cone-shaped deep umbilicus with abrupt umbilical wall joined the flanks without the shoulder. Whorls are strongly depressed. Venter is wide, rounded. Up to diameter 35 mm, the shell is smooth bearing the only deep constrictions bent adorally (5–9 constrictions per one volution). Primary and secondary ribs appear on the adult stage of growth. Primaries start from the umbilical border, sometimes from very weak umbilical bullae and pass along the constrictions. From 3 to 5 secondaries are usually settled between the pair of primaries. All ribs are bent adorally on the venter. Sometimes at the ventrolateral margin secondaries branch in pair of ribs with the thickness equal to that of the primaries.

Comparison: Described species differs from the closest species *Tongoboryceras tongoboryense* (COLLIGNON) by the lower whorls, deeper constrictions and less curving, almost straight coarser ribs.

Occurrence: Upper Turonian of Crimea, Kopetdag, South Armenia, France, England, Germany, Austria.
Material: 12 specimens (50–52/330, 7–9/12945, 16–21/12944).

Genus *Eupachydiscus* SPATH, 1922

Middle-sized or large shell, moderately involute. The early whorl section is low and inflated. Later the height increases more rapidly than the width. On the adult whorls the height often exceeds the width. Sculpture consists of ribs crossing the venter without interrupting and weak umbilical tubercles. On the adult whorls ribs become thicker and umbilical tubercles weaker and then disappear.

Coniacian – Campanian.

Eupachydiscus cf. *sayni* (DE GROSSOUVRE, 1894)

Plate 10, fig. 12

1894 *Pachydiscus sayni* DE GROSSOUVRE, p. 181, pl. 29, fig. 2.
1988 *Eupachydiscus sayni* – THOMEL, p. 46, pl. 7, fig. 1.

Shell discoidal, moderately involute. Umbilicus width is about 27–30 % of shell diameter. Whorl section oval, compressed. Sculpture consists of primary and secondary ribs. The former start from umbilical wall and transform into elevated elongated tubercles on the umbilical shoulder. On the flanks ribs are slightly bent forward. Secondaries arise at the different levels at the lower parts of the flanks (up to 3 secondaries between the pair of primaries). All ribs cross the venter being bent adorally. On the venter from 40 to 50 ribs occur per whorl.

Comparison: Differs from *Eupachydiscus levyi* (DE GROSSOUVRE) generally by less dimensions.

Occurrence: Upper Santonian of Crimea; Santonian of South-East France, Rumania, Bulgaria.
Material: 1 specimen (53/330).

Eupachydiscus levyi (DE GROSSOUVRE, 1894)

Plate 11, figs. 3–5

1894 *Pachydiscus levyi* DE GROSSOUVRE, p. 178, pl. 21; pl. 30, figs. 1, 2.
1988 *Eupachydiscus levyi* – THOMEL, p. 39, pl. 8, fig. 2; pl. 9, figs. 2, 3, 4; pl. 11, figs. 1, 2; pl. 12, 13, 14, 15, 16; pl. 17, fig. 1; pl. 20; text-fig. 21.
1994 *Eupachydiscus levyi* – WIEDMANN, p. 236, pl. 43, figs. 8, 9.

Shell large, moderately involute, with high oval whorl section. Umbilicus width on the different stages of growth is from 27 to 32 % of shell diameter. Sculpture is represented by primary and secondary ribs and weak umbilical bullae, settled on the primaries. From 1 to 3 secondaries arising at the different levels of the flanks occur between the primaries. Ribs are slightly bent adorally on the flanks and strongly on the venter. On the body chamber primaries become coarser, umbilical nodes disappear and secondaries become weaker being completely

gone near the peristome. One volution bears about 14–15, rarely from 10 to 20 primaries. According to the shell growth the total number of ribs declines from 42 to 30 per one whorl and to 26 ones on the body chamber.

Comparison: Differs from the other species of *Eupachydiscus* genus by higher whorl sections.

Occurrence: Lower Campanian of Crimea, Caucasus, Kopetdag, Poland, France, Netherlands, Spain.
Material: 11 specimens (56/330, 2/8304, 6–7/8304, 61/8304, 10/10840, 10–14/12945).

Genus *Pachydiscus* Zittel, 1884

Shell of large and middle sizes, moderately involute with high or low oval whorl section. Sculpture consists of primary and secondary ribs and umbilical bullae or not.

Campanian – Maastrichtian.

Pachydiscus haldemsis (Schluter, 1867)

Plate 13, figs. 1–3

1867 *Ammonites haldemsis* Schluter, p. 19, pl. 3, fig. 1.
1894 *Pachydiscus koeneni* – de Grossouvre, p. 178.
1974 *Menuites ambiguus* – Najdin, p. 182, pl. 63, fig. 2.
1986 *Pachydiscus (Pachydiscus) haldemsis* – Kennedy, p. 45, pl. 4, figs. 1–3; pl. 5, figs. 7–14; text-fig. 11A–D, F, G; text-fig. 17.

This species is found to possess the dimorphism. Microconchs when adult have a diameter of about 100–110 mm, while the macroconchs of about 330–350 mm. On the early stages of growth shell is moderately evolute. Umbilicus width is about 30 % of the shell diameter. Whorl section is high oval. When the shell diameter is 35 mm, the volution bears 16 weak umbilical bullae. Every bullae gives rise to one narrow primary rib, disappearing on the venter. Microconchs having a diameter more than 40 mm at the end of the ribs bear sharp ventrolateral clavi which are connected to each other through the venter by a feeble transverse rib. First and then second secondary ribs appear between the primaries, pass through the flanks and disappear on the venter. Ventrolateral clavi occur only on the middle stage of shell growth and disappear when its diameter reaches 60 mm. From this stage the ribbing frequency is increasing according to shell growth. On the body chamber there are found 35–38 ribs; 16–19 ones among them are primaries. Macroconchs do not bear ventrolateral clavi. One or two primaries arise from the narrow umbilical bullae, between them there are settled one or two secondaries starting from the different parts of the flanks. All ribs pass through the venter with the distinct bend forward. The number of primaries is not more than 20–23 per one volution, the total rib number is about 60 per one whorl. Near the peristome the secondaries are absent.

Comparison: Microconchs of this species differ from *Pachydiscus oldhami* (Sharpe) by coarser ribbing which is present also on the adult stage.

Occurrence: Upper Campanian of Crimea, Caucasus, Donbass, Kopetdag, Poland, France, Germany, Sweden, Northern Ireland (?).
Material: 9 specimens (61–64/330, 15–18/12945, 56/8304).

Pachydiscus epiplectus (Redtenbacher, 1873)

Plate 14, fig. 3

1873 *Ammonites epiplectus* Redtenbacher, p. 121, pl. 28, fig. 1.
1951 *Pachydiscus colligatus* – Mikhailov, p. 56, pl. 5, figs. 29–30 (non pl. 5, fig. 28; text-fig. 20 (= *P. sersensis* Atab. & Hakob.)).
1986 *Pachydiscus (Pachydiscus) epiplectus* – Kennedy & Summesberger, p. 192, pl. 6, figs. 3, 4; pl. 7, figs. 1, 2; pl. 8, figs. 1, 2; pl. 9; pl. 10, figs. 1–3; pl. 11, figs. 1–4; pl. 12; pl. 13, figs. 1–3; text-figs. 5C, D.
1993 *Pachydiscus (Pachydiscus) epiplectus* – Hancock & Kennedy, p. 160, pl. 11, figs. 1–4; pl. 14, figs. 1, 5; pl. 15, figs. 13, 14.
1993 *Pachydiscus (Pachydiscus) epiplectus* – Ward & Kennedy, p. 38, figs. 28.4, 28.5, 30.5, 35.1, 35.2, 35.4, 40.4.

Shell flattened, involute, with oval whorl section. The largest width of the whorl is near umbilical shoulder. Umbilical wall and umbilical shoulder rounded. Slightly convex flanks. Wide, convex venter (pictured specimen no. 66/330 is deformed). Sculpture consists of primary and secondary ribs and weak umbilical bullae. Simple primary ribs or pair of primaries start from the umbilical shoulder (sometimes from umbilical bullae). Secondaries

(one or two between primaries) arise at the different parts of the flanks. The total number or ribs is 50–55 per one volution. Among them 16 – 22 ribs are the primary ones. All ribs cross the venter with the bend forward.

Comparison: Differs from *Pachydiscus colligatus* (BINKHORST) by the more involute shell.

Occurrence: Lower Maastrichtian of Crimea, North Caucasus, West Ukraine, Armenia, South-West France, Italy, Austria, Bulgaria.

Material: 3 specimens (66/330, 22–23/12944).

Pachydiscus neubergicus (VON HAUER, 1858)

Plate 14, figs. 1–2

1858 *Ammonites neubergicus* VON HAUER, p. 12, pl. 2, figs. 1–3, non pl. 3, figs. 1, 2.
1951 *Pachydiscus gollevillensis* – MIKHAILOV, p. 66, pl. 8, fig. 39; text-fig. 24.
1959 *Pachydiscus neubergicus* – NAJDIN, p. 186, pl. 10, figs. 1–3; text-fig. 18A.
1986 *Pachydiscus (Pachydiscus) neubergicus* – KENNEDY & SUMMESBERGER, p. 189, pl. 2, figs. 1–2; pl. 3, figs. 1–3; pl. 4, figs. 1–5; pl. 5, figs. 1, 4, 5; pl. 6, figs. 1, 2, 5; pl. 15, figs. 7–8; text-figs. 5a, b.
1993 *Pachydiscus (Pachydiscus) neubergicus neubergicus* – HANCOCK & KENNEDY, p. 158, pl. 3, figs. 6, 7; pl. 9, figs. 5–8; pl. 12, figs. 7–9; pl. 13, figs. 5–7.
1993 *Pachydiscus (Pachydiscus) neubergicus neubergicus* – WARD & KENNEDY, p. 30, figs. 25.9, 25.10, 25.11, 25.12, 25.14, 25.16–25.18, 27.3–27.5, 27.7, 28.1–28.3, 30.4, 30.6.

Shell involute with high oval whorl section. Umbilicus is not deep. Its width is about 28–30% of shell diameter. Umbilical wall low, rounded. Slightly convex flanks. Narrow convex venter. Early whorls are smooth. Sculpture of the adult whorls consists of primaries and secondaries and umbilical bullae. Primaries appear when the shell diameter reaches 40–45 mm and remain up to the end of the growth. On the body chamber they become coarser, more flattened, interspaces become wider. Near the umbilicus primaries transform into coarse elongated nodes, further they advance with the bend forward and finely disappear at the upper half of the flanks. When the shell diameter is 40–60 mm, one whorl bears 11–13 primaries. Secondaries arise when the shell diameter reaches 50–60 mm and are practicall smoothed only on the body chamber near the peristome. Numerous, weaker than primaries, secondary ribs occur only on the venter and upper parts of flanks. Between pair of primaries from 1 to 3 secondaries are settled, on the one volution from 48 to 60 ones.

Comparison: Differs from *Pachydiscus armenicus* ATABEKIAN & HAKOBIAN by the less total number of ribs.

Occurrence: Upper Maastrichtian of Crimea, North Caucasus, Armenia; Lower Maastrichtian of Kopetdag, West Ukraine, North Spain, France, Germany, Austria, Poland, Bulgaria, Nigeria, South Africa, Madagascar; lower part of Upper Maastrichtian of Denmark, South India.

Material: 8 specimens (65/330, 11/3962, 19–23/12945, 21/12943).

Pachydiscus gollevillensis (D'ORBIGNY, 1850)

Plate 13, fig. 4

1850 *Ammonites gollevillensis* D'ORBIGNY, p. 212.
1951 *Pachydiscus neubergicus* var. *nowaki* – MIKHAILOV, p. 65.
1959 *Pachydiscus gollevillensis* – NAJDIN, p. 187, pl. 11, figs. 1–3.
1986 *Pachydiscus (Pachydiscus) gollevillensis* – KENNEDY, p. 28, pl. 1–3; pl. 4, figs. 4–6; pl. 5, figs. 12–14, 20–24; pl. 11, figs. 1–5; text-figs. 2, 3P, R, 4C.
1993 *Pachydiscus (Pachydiscus) gollevillensis* – WARD & KENNEDY, p. 34, figs. 29.6, 31.1, 31.5, 32.1–32.3, 33.

Flattened involute shell with high oval whorl section. Umbilicus width is 22 – 27% of shell diameter. Rounded low umbilical wall. Shell with slightly convex flanks and rounded weakly convex venter. Up to diameter 16 – 20 mm shell is smooth. Weak umbilical bullae appear when the diameter is 20 – 40 mm. The umbilical bullae give rise to primaries going to the middle of the flanks, where they become weaker and finally disappear. Secondaries occur on the upper parts of flanks, when the shell diameter is 40 – 45 mm and they cross the venter. Adult whorls bear from 8 to 14 primary and from 50 to 80 secondary ribs.

Comparison: Differs from *Pachydiscus neubergicus* (VON HAUER) by the less number of primaries and higher number of secondaries.

Occurrence: Upper Maastrichtian of Crimea, Caucasus, Kopetdag, France, North Spain, Netherlands, North Germany, Austria, Poland, Bulgaria, South India (?) and Madagascar.

Material: 3 specimens (22/12943, 24–25/12944).

Superfamily Acanthocerataceae de Grossouvre, 1894

Family Brancoceratidae Spath, 1900

Subfamily Mortoniceratinae H. Douvillé, 1912

Genus *Mortoniceras* Meek, 1876

Shell from evolute to moderately involute with rectangular or square whorl section and well-defined keel on the wide venter. Sculpture consists of two, three or four rows of tubercles, primary and secondary ribs. On the young whorls primaries arise from the umbilical tubercles by single rib or in pairs. Sometimes secondaries occur between primaries. Adult whorls bear the only single coarse ribs with wide interspaces. Often all ribs are covered by spiral striation.

Upper Albian.

Mortoniceras rostratum (J. Sowerby, 1817)

Plate 8, figs. 1–2

1817 *Ammonites rostratus* J. Sowerby, p. 163, pl. 173.
1976 *Mortoniceras (Mortoniceras) rostratum* – Marcinowski & Naidin, p. 108, pl. 5, fig. 1; pl. 9, fig. 2.
1985 *Mortoniceras (Subschloenbachia) rostratum* – Immel & Seyed-Emami, p. 96, pl. 3, fig. 2.

Evolute shell of large and moderate sizes with compressed rectangular whorl section. Umbilicus width is about 36–39 % of shell diameter. Inner whorls are covered by thick ribs with four rows of tubercles: umbilical, lateral, and closely spaced inner and outer ventrolateral. On this stage of growth ribs start from the umbilical tubercles in pairs, rarely in simple rib. One volution bears 36–40 ribs. Tubercles of all ribs are well-defined, rounded. When shell diameter reaches 100 mm, ribs become coarser, simple with very wide rib interspacing. Two rows of ventrolateral tubercles join into the single row, tubercles become stronger, spine-shaped and elevated above the well-defined keel. The other tubercles also become higher and umbilical ones lengthen along the ribs, while lateral ones approach to the venter.

Comparison: Differs from *Mortoniceras pachys* (Seeley) by more distant ribs and four rows of tubercles.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, Minor Caucasus, Kopetdag, England, France, Spain, Germany, Hungary.

Material: 5 specimens (40/330, 26–28/12944, 42/12944).

Mortoniceras cf. *perinflatum* (Spath, 1922)

Plate 9, fig. 1

1859 *Ammonites inflatus* – Pictet & Campiche, p. 178–181, pl. 21, fig. 5; pl. 22, fig. 3.
1976 *Mortoniceras (Durnovarites) perinflatum* – Marcinowski & Naidin, p. 109, pl. 6, figs. 1–2.
1985 *Mortoniceras (Subschloenbachia) perinflatum* – Immel & Seyed-Emami, p. 97, pl. 3, fig. 3.

Shell moderately involute. Umbilicus width usually is about 26–33 % of shell diameter. Low whorls with rounded rectangular whorl section. Venter is broadly flattened with the low thick keel. Flanks are covered by ribs bearing several rows of tubercles. Inner whorls (up to diameter 70–80 mm) bear four rows of tubercles: umbilical, two rows of lateral and one row of ventrolateral ones. Ribs start in pairs from the umbilical tubercles. There occur 16–20 umbilical nodes and 30–40 ribs per one whorl. Near the ventral shoulder ribs are strongly bent adorally. Umbilical nodes are slightly lengthened along the ribs, lateral ones are rounded and ventrolateral ones are obliquely clavate. At a shell diameter of 80 mm ribs become coarser, more distant, arising as a single rib from the umbilical nodes. On this stage, the only three rows of tubercles occur and the largest ventrolateral tubercles are clavate.

Comparison: Differs from *Mortoniceras rostratum* (J. Sowerby) by the more narrow umbilicus and lower whorl section.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, Minor Caucasus, England, France, Switzerland, Hungary, Rumania, Central Iran, and Angola.

Material: 1 specimen (41/330).

Family Acanthoceratidae de Grossouvre, 1894

Subfamily Mantelliceratinae Hyatt, 1903

Genus *Mantelliceras* Hyatt, 1903

Shell from moderately involute to evolute with compressed or depressed whorl section of different shape (rectangular, trapezoid, polygonal, rarely rounded). Flanks are covered by primary and secondary ribs and three or four rows of tubercles. Ribs are coarse. Primaries arise from umbilical nodes in pairs or by single ribs. All ribs cross the venter.

Lower Cenomanian.

Mantelliceras picteti Hyatt, 1903

Plate 10, fig. 4

1859 *Ammonites mantelli* – Pictet & Campiche, p. 200, pl. 26, figs. 1, 2, 3.
1984 *Mantelliceras picteti* – Wright & Kennedy, p. 117, pl. 27, figs. 1–5; pl. 28, figs. 1–3; text-figs. 25G, 27I, N–Q.
1991 *Mantelliceras picteti* – Delamette & Kennedy, p. 448, figs. 12.5, 12.6, 12.9, 12.10, 12.13, 12.14.

Shell discoidal with high whorl section, flattened flanks and narrow flattened venter. Umbilicus width is from 30 to 40% of shell diameter. Flanks are covered by coarse ribs. Primaries start from umbilical nodes as simple ribs or in pairs and bear four rows of tubercles. Secondaries (1–2 between primaries) bear only two rows of ventrolateral tubercles. On the body chamber tubercles become smoothed while ribs are strengthened.

Comparison: Differs from *Mantelliceras mantelli* J. Sow. by the higher whorls.

Occurrence: Lower Cenomanian of Crimea, Kopetdag, Podolia, England, France, North Spain, Switzerland, Rumania, Bulgaria, Iran, and Madagascar.

Material: 1 specimen (47/330).

Suborder Ancyloceratina Wiedmann, 1960

Superfamily Ancyloceratacea Gill, 1871

Family Hemihoplitidae Spath, 1924

Genus *Pseudothurmannia* Spath, 1923

Shell evolute. Whorls are high, very slightly impressed dorsally, on the adult stage unrolled. Flanks are flattened. Whorl section is rounded-rectangular. Ribs are curved, simple, sometimes branched accompanied by ventral and weakly elevated umbilical tubercles. Ribs cross the venter without interruption.

Upper Hauterivian.

Pseudothurmannia picteti (Sarcar, 1955)

Plate 4, fig. 1

1955 *Pseudothurmannia picteti* Sarcar, p. 156.
1960 *Pseudothurmannia picteti* – Drushchits, p. 288, pl. 30, fig. 6.

Evolute shell with rectangular whorl section, slightly rounded venter and flattened flanks. Sculpture is represented by primary and secondary ribs. More strong primaries form elongated tubercles (bullae) near the umbilicus. Sometimes they branch into two ribs. One or two weaker secondary ribs arising above the umbilicus are settled between the primary ones. Ribs are straight and cross the venter with some wide bending forward.

Comparison: Differs from *P. angulicostata* Orb. by shorter secondaries.

Occurrence: Upper Hauterivian of Crimea, Caucasus, West Europe.
Material: 1 specimen (22/330).

Superfamily Turrilitaceae Gill, 1871

Family Hamitidae Gill, 1871

Genus *Hamites* Parkinson, 1811

On the early stage shell consists of the unadjacent whorls coiled either in the same plane or in screw. The subsequent stage is represented by two or three straight or curved almost parallel shafts connected to each other by abrupt bends. Whorl section of these shafts varies from rounded to oval. Peristome is usually rounded. Sculpture consists of single ring-shaped ribs slightly strengthened on the venter and weakened on the dorsum. Peristome part of the shell sometimes bears two coarse ribs divided by deep constriction. Perfectly preserved fossil shells of this genus occur exclusively rarely.

Albian – Cenomanian.

Hamites virgulatus Brongniart, 1822

Plate 7, figs. 2–3

1822 *Hamites virgulatus* Cuvier & Brongniart, pl. C, fig. 6.
1976 *Hamites (Stomohamites) virgulatus* – Marcinowski & Naidin, p. 98, pl. 1, figs. 4–5.
1990 *Hamites virgulatus* – Henderson, p. 130, figs. 13A–E, I–Q.

Completely saved young whorls of the shell are unknown. Having into collection, the fragments of the whorl shafts are weakly curved with rounded whorl section sometimes slightly compressed. Sculpture is represented by simple ring-shaped ribs weakening on the dorsum and, in contrary, strengthening on the venter. On the shafts fragment with the length equal to its height there are counted from 4 to 5 ribs.

Comparison: Differs from *Hamites venetzianus* Pictet by the thicker whorls and more dense and comparatively thin ribbing.

Occurrence: Upper Albian (upper part) of Crimea, Kopetdag, England, France, Spain, Italy, Switzerland, Hungary, Rumania, Africa, Madagascar, Austria, Venezuela.
Material: 2 specimens (32–33/330).

Family Anisoceratidae Hyatt, 1900

Genus *Anisoceras* Pictet, 1854

The inner whorls are coiled helical, then they transform into straight or slightly curved shafts and often completed by the final hook. Sculpture is represented by lateral and ventrolateral tubercles connected to each other by loops of two ribs (sometimes one or three ribs). Lateral tubercles of some species may be absent or weakened. Secondary nontuberculate ribs occur into primary rib interspaces.

Upper Albian – Cenomanian.

Anisoceras perarmatum Pictet & Campiche, 1861

Plate 7, figs. 13–14

1861 *Anisoceras perarmatus* Pictet & Campiche, p. 65, pl. 48, fig. 7; pl. 49, figs. 1–3, 6–8.
1982 *Anisoceras (Anisoceras) perarmatum* – Renz, p. 60, pl. 20, figs. 1a–b, 3.

The whorl section of shafts is rounded six-angular. Sculpture consists of primary and secondary ribs and four rows of tubercles (on both flanks): two lateral and two ventrolateral. On the early stages primaries arise in pairs from the lateral nodes, join together in the ventrolateral tubercles, and here branch in pairs again, then crossing the venter and connecting with the tubercles of the opposite side. At the dorsum primaries weaken up to the thickness of secondary ribs. One or two secondaries are settled between two primary ribs. On the adult whorls secondaries disappear and on the body chamber tubercles sometimes join with the only one primary rib.

Comparison: Differs from *Anisoceras armatum* J. Sowerby by the absence of all secondary ribs on the adult whorls.

Occurrence: Upper Albian (upper part) of Crimea, Minor Caucasus, Kopetdag, Germany, England, France, Italy, Switzerland, Hungary, Rumania, Africa, Madagascar, South India, Texas, and Venezuela.

Material: 10 specimens (39/330, 29–37/12944).

Genus *Allocrioceras* Spath, 1926

On the early stage shell consists of unadjacent whorls coiled in the same plane or helical. On the adult stage whorls are coiled in the other plane settled at the angle more than 90° to the plane of previous coiling. Whorl section is oval, compressed. Sculpture is represented by single circular ribs bearing two rows of tubercles settled along the bottom sides of the venter either on every rib or on some of them. In the last case between two ribs bearing tubercles there occur 1–4 ribs without them.

Turonian – Coniacian.

Allocrioceras strangulatum Wright, 1979

Plate 10, fig. 3

1841 *Hamites ellipticus* – Roemer, p. 93, pl. 14, fig. 5.
1979 *Allocrioceras strangulatum* Wright, p. 291, pl. 1, figs. 12–14; pl. 2, fig. 1.
1989 *Allocrioceras strangulatum* – Kaplan, p. 79, pl. 4, fig. 3; pl. 7, fig. 2; pl. 8, figs. 1–4; pl. 9, fig. 1.

Shell consists of free unadjacent whorls coiled in the same plane. Whorl section is oval, compressed. Sculpture consists of single circular ribs and rare weak constrictions. Each rib bears two nodes approached to the venter. On the whorl length equal to its height there occur from 5 to 11 ribs.

Comparison: Differs from *Allocrioceras angustum* J. Sowerby by the type of coiling, higher whorl section and equidimensional tubercles on all the ribs.

Occurrence: Upper Turonian of Crimea, England, North France, and Germany.

Material: 1 specimen (46/330).

Family Turrilitidae Gill, 1871

Subfamily Turrilitinae Gill, 1871

Genus *Ostlingoceras* Hyatt, 1900

Shell of very close coiling (*Turrilites* type of coiling) with narrow umbilicus and high whorls with pentagonal or rhombic whorl section and acute spiral angle. External part of the whorls is flattened slightly concave or weakly convex. The upper side is strongly concave. Sculpture consists of ribs and two or three rows of tubercles settled either on or near lower external shoulder of the whorls.

Upper Albian (upper part) – Lower Cenomanian.

Ostlingoceras puzosianum (d'Orbigny, 1842)

Plate 7, figs. 9–12

1842 *Turrilites puzosianus* d'Orbigny, p. 587, pl. 143, figs. 1–2.
1985 *Ostlingoceras (Ostlingoceras) puzosianum* – Atabekian, p. 47, pl. 7, fig. 6; pl. 11, figs. 4–7; pl. 12, figs. 1–9; pl. 13, figs. 1–9; pl. 14, figs. 1–5; pl. 17, fig. 6.
1990 *Ostlingoceras puzosianum* – Marcinowski & Wiedmann, p. 51, pl. 4, fig. 13.

Shell coiled sinistral. High whorls with flattened or slightly convex flanks. Spiral angle varies from 14 to 22°, rarely reaches 29°. From 22 to 44 ribs bearing three rows of small tubercles occur on the lower part of the whorls. Tubercles are settled on the lower external shoulder, so as the tubercles of the first row are covered by the subsequent whorls. On the upper part of the whorl the number of ribs is 20–34 per whorl.

Comparison: Differs from *Ostlingoceras puzosiforme* Spath by coarser and less flexuos ribs, and covered first row of tubercles, and their round shape.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, North Caucasus, Minor Balkhan, Kopetdag, England, France, Spain, Italy, Austria, Hungary, Rumania, Poland, Iran, Madagascar, and North Africa.

Material: 5 specimens (36–38/330, 123–124/9431).

Genus *Mariella* Nowak, 1916

Shell of *Turrilites* type of coiling. Whorls of either sinistral or dextral coiling are closely adjacent to each other. Spiral angle varies into the wide ranges. Sculpture consists of single simple or looped ribs bearing from two to four rows of tubercles. All rows contain the same number of tubercles.

Upper Albian – Lower Cenomanian.

Mariella crassituberculata Spath, 1937

Plate 7, fig. 8

1862 *Turrilites bergeri* – Pictet & Campiche, p. 134, pl. 58, figs. 3a, 4.
1968 *Mariella (Mariella) crassituberculata crassituberculata* – Renz, p. 86, pl. 18, figs. 5, 6a, b; text-figs. 31a, 32i.
1970 *Paraturrilites (Bergericeras) bergeri* var. *crassituberculata* – Collignon, p. 29, pl. 6, fig. 4.

The spiral angle is about 30–32°. One whorl bears from 21 to 27 weak ribs decorated by four large equidistant tubercles. Tubercles of the lower row are partly covered by subsequent volution.

Comparison: Differs from *Mariella bergeri* Brongniart by weaker ribs and larger tubercles.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, England, Switzerland, Spain, France, Italy, Rumania, and Madagascar.

Material: 1 specimen (35/330).

Mariella bergeri (Brongniart, 1822)

Plate 7, figs. 4–7

1822 *Turrilites bergeri* Brongniart, p. 395, pl. 7, fig. 3.
1985 *Mariella (Mariella) bergeri* – Atabekian, p. 27, pl. 2, figs. 4–5; pl. 3, figs. 1–11; pl. 4, figs. 1–7.
1990 *Mariella (Mariella) bergeri* – Henderson, p. 133, figs. 15M, N.

Spiral angle varies from 15 to 43°. Sculpture consists of thin ribs bearing four equidimensional tubercles. They form four rows, three of them can be seen on the external part of the whorl, while the fourth one is covered by the subsequent volution. Tubercles of the upper row are slightly lengthened along the ribs, other tubercles have rounded shape. Rows settled equidistantly. One whorl bears from 20 to 40 ribs.

Comparison: Differs from *Mariella cantabrigiensis* (Jukes-Browne) by the equal dimensions of all tubercles, round shape of tubercles of three lower rows and equal spaces between them.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, Caucasus, Tuarkyr, Kopetdag, Poland, West Europe, Iran, Australia, Madagascar, South and North Africa and America (California, Argentina).

Material: 4 specimens (34/330, 39/9431, 120/9431, 197/9431).

Subfamily Nostoceratinae Hyatt, 1894

Genus *Bostrychoceras* Hyatt, 1900

Shell of *Bostrychoceras* type consisting of whorls of either dextral or sinistral coiling. Young whorls do not attach to each other, adult ones are adjacent. Body chamber of hook shape diverging from other parts. Peristome is directed to the side under the angle 40–55° to the axis of coiling of shell spiral part. Whorl section is rounded or oval. Sculpture consists of dense usually thin single, rarely biplicate ribs either bearing tubercles or not.

Campanian – Lower Maastrichtian.

Bostrychoceras polyplocum (Roemer, 1841)

Plate 12, figs. 3–5

1841 *Turrilites polyplocus* Roemer, p. 92, pl. 14, fig. 1.
1974 *Bostrychoceras polyplocum* – Najdin, p. 165, pl. 54, figs. 1–3; pl. 55, fig. 1.

1986 *Nostoceras (Bostrychoceras) polyplocum* – KENNEDY, p. 92, pl. 6, fig. 1; pl. 15, figs. 1–3, 5–8; pl. 22, fig. 3; text-figs. 32A–B, 33A–E, 34A–H, 35A–D.

Shell of either dextral or sinistral coiling. Up to diameter 20–25 mm whorls are not adjacent. Spiral angle varies in the wide range. Whorl section rounded. Sculpture consists of dense thin ribs (80 – 90 ones per one volution) and rare constrictions (2–3 per one whorl). Ribs bearing tubercles interchange with ribs without ones (one or two). Ribs usually bear two tubercles forming two rows on the shell surface. One row is settled on the lower part of the external side of the whorl and another one on the shoulder between the external and lower side of the whorl. When the shell diameter is more than 25 mm, whorls become adjacent, tubercles disappear, only ribs and rare constrictions remain. Body chamber is hook-shaped. Ribs cross the external side.

Comparison: Differs from *Bostrychoceras densiplicatum* TSANKOV by less dense ribbing and absence of tubercles on the adult stage.

Occurrence: Upper Campanian (Bostrychoceras polyplocum Zone) of Crimea, North Caucasus, Donbass, Caspian Depression, Kopetdag, England, France, Germany, Spain, Poland, Bulgaria, Belgium, Iran, Iraq, North Africa, Texas (USA).

Material: 4 specimens (59/330, 8/9391, 24/12945, 50/8304).

Subfamily Diplomoceratinae SPATH, 1926

Genus *Parasolenoceras* COLLIGNON, 1969

Shell is coiled in one plane and consists of some straight or slightly curved shafts. Whorl section is rounded or oval. Sculpture is represented by single or rarely biplicate circular ribs. Each rib bears a pair of ventrolateral tubercles usually flattened. Ribs and tubercles can be either equidimensional ones or of different sizes.

Campanian.

Parasolenoceras cf. *phaleratum* (GRIEPENKERL, 1889)

Plate 12, fig. 2

1889 *Hamites phaleratus* GRIEPENKERL, p. 406, pl. 11 (44), fig. 3; pl. 12 (45), figs. 3–4.

1974 *Neancyloceras phaleratum* – NAJDIN, p. 169, pl. 56, fig. 6; pl. 57, figs. 1, 3.

1984 *Pseudoxybeloceras (Parasolenoceras)* cf. *phaleratus* – KENNEDY & SUMMESBERGER, p. 168, pl. 6, figs. 4, 5; pl. 10, figs. 5, 6 (with synonymy).

Shell consists of no more than four slightly curved almost parallel shafts linked by the abrupt bends. Whorl section is oval. Sculpture is represented by primary and secondary ribs some weakened on the inner side. Ribs bear one row of tubercles along the external side. Tubercles settled on the opposite sides are joined to each other by the hoop of biplicated primaries or by the zigzag single secondary ribs. Primaries bear larger tubercles than secondaries. Between two primaries there occur one or two secondary ribs.

Comparison: Differs from *Parasolenoceras interruptum* (SCHLUTER) by the curved shafts, coarser primaries and weaker secondaries and tubercles.

Occurrence: Upper Campanian (lower part) of Crimea, Donbass, Germany, Austria, Poland, Afghanistan.

Material: 3 specimens (58/330, 25–26/12945).

Genus *Diplomoceras* HYATT, 1900

Shell consists of several parallel or almost parallel shafts joined to each by elbow- or U-shaped bends. Whorl section is rounded or oval. Sculpture is represented by dense single usually thin circular ribs, directed radially or slightly bent forward (adorally). Ribs slightly weaken on the inner sides of the shafts. Rare constrictions occur.

Maastrichtian.

Diplomoceras cylindraceum (DEFRANCE, 1816)

Plate 15, fig 1; Plate 16, figs. 7–8

1816 *Baculites cylindracea* DEFRANCE, p. 160.

1951 *Diplomoceras cylindraceum* var. *lvovensis* – MIKHAILOV, p. 42, pl. 2, figs. 7, 8; text-figs. 11a, b.

1959 *Diplomoceras cylindraceum* – NAJDIN, p. 181, pl. 3, fig. 2.
1993 *Diplomoceras cylindraceum* – HANCOCK & KENNEDY, p. 164, pl. 15, fig. 15; pl. 17, figs. 1–4.
1993 *Diplomoceras cylindraceum* – WARD & KENNEDY, p. 49, figs. 42, 43.16, 43.17.

Shell consists of no more than four almost parallel shafts linked by U-shaped segments. The maximum length of the last adult shaft containing body chamber reaches 1 m. Whorl sections varies from round to oval. Sculpture is represented by dense sharp circular ribs some weakening on the inner parts of the shafts. Rib thickness is less than rib interspace width. Weak constriction occurs very rarely. Relative density of ribbing is increasing with the shell growth: on the early stages of growth shaft length equal to its height bears about 7 ribs, on the adult stages up to 24 ribs.

Notes. In the genus *Diplomoceras* there have been identified 22 species. Further investigations of these taxa by the different authors show the majority of them to belong really to genus *Glyptoxoceras*. In the genus *Diplomoceras* there are remaining *D. notabile* WHITEAVES, *D. lambi* SPATH, *D. australe* HUNICKEN, *D. parahibense* MAURY, *D. maximum* OLIVERO & ZINSMEISTER and subspecies *D. cylindraceum lvovensis* MICHAILOV. According to investigations of this genus population in North Europe (KENNEDY 1986a, 1986b; KENNEDY & SUMMESBERGER 1986) and in Australia (HENDERSON et al. 1992) five species mentioned above and the subspecies *D. cylindraceum lvovensis* MICHAILOV are the synonyms of type species of this genus. So, the genus *Diplomoceras* appears to be monotypical. In the Crimea region there is not found the corresponding material for the detailed study of interspecific variability. However, these species findings in Crimea, Armenia, and Kopetdag show that in the Lower Maastrichtian (Nostoceras hyatti Zone = Hauericeras sulcatum Zone) morphotypes "*notabile*" with coarser ribbing are prevailing (Plate 15, fig. 1), while in the Upper Maastrichtian the morphotypes "*cylindraceum*" (Plate 16, fig. 8).

Occurrence: Maastrichtian of Crimea, Caucasus, Middle Asia, Koryakskoye Plateau, Europe, North and South America, Antarctica, South Africa, Madagascar, South India, Australia.
Material: 10 specimens (67/330, 23–24/12943, 38–41/12944, 27–29/12945).

Genus *Neoglyptoxoceras* COLLIGNON, 1869

Shell of crioceratid type of coiling consists of several unadjacent whorls coiled in one plane. Whorl section is round or oval. Sculpture consists of single circular ribs weakening on the inner part of the whorls.

Campanian.

Neoglyptoxoceras retrorsum (SCHLUTER, 1872)

Plate 11, fig. 2

1872 Ancyloceras retrorsum SCHLÜTER, p. 97, pl. 30, figs. 5–10.
1959 *Neancyloceras retrorsum* – NAJDIN, p. 182, pl. 3, fig. 7.
1986 *Neoglyptoxoceras (?) retrorsum* – KENNEDY, p. 106, pl. 16, figs. 1–4, 6–7; pl. 17, figs. 1, 2; text-fig. 38.

Shell with free, non-adjacent whorls. Whorl section is oval. Sculpture consists of monotonic simple ribs. Rib interspaces are almost twice wider than rib thickness. The whorl length equal to its height, bears 5–7 ribs.

Comparison: Differs from *Neoglyptoxoceras magnificum* COLLIGNON by the less shell dimensions and more dense ribbing.

Occurrence: Upper Campanian of Crimea, Germany, and Austria; Lower Campanian of Poland;Campanian of Caucasus, France.
Material: 1 specimen (55/330).

Family Baculitidae GILL, 1871

Genus *Lechites* NOWAK, 1908

Shell of *Baculites* type of coiling consists of one spiral whorl with subsequent straight shaft with round or oval whorl section. Sculpture consists of broad or almost flat wide or narrow circular ribs weakening on the inner (antisiphonal) side of shaft.

Upper Albian.

Lechites moreti Breistroffer, 1936

Plate 7, fig. 1

1861 *Baculites gaudini* var. – Pictet & Campiche, p. 112, pl. 55, figs. 10, 11.
1979 *Lechites gaudini moreti* – Scholz, p. 14, pl. 1, fig. 10; text-fig. 5C.
1981 *Lechites moreti* – Chiriac, p. 63, pl. 3, figs. 7–9.
1988 *Lechites moreti* – Delanoy & Latil, p. 752, pl. 1, figs. 4a–c.

Oval, almost round whorl section. Sculpture consists of wide flattened ribs with very narrow and deep rib interspaces looking like constrictions. Ribs weaken on the inner (antisiphonal) side of the trunk.

Comparison: Differs from *Lechites gaudini* Pictet & Campiche by wide flat ribs.

Occurrence: Upper Albian (Stoliczkaia dispar Zone) of Crimea, England, France, Italy, Switzerland, Hungary, Rumania.
Material: 1 specimen (31/330).

Superfamily Scaphitaceae Gill, 1871

Family Scaphitidae Gill, 1871

Subfamily Scaphitinae Gill, 1871

Genus *Scaphites* Parkinson, 1811

Shell of *Scaphites* type of coiling. Early whorls in contact. The last whorl is straightened away in its beginning and then transforms into a hook curved to the spiral part of the shell. Hook can be either impressed to the spiral or be non-adjacent. Sculpture of the coiled part consists of dense thin winding single and branched ribs crossing the venter without interruption. Sculpture on the body chamber is another one and consists of coarse distant ribs on the flanks and thin ones on the venter, and from one to three rows of tubercles appear on the flanks.

Upper Albian – Campanian.

Scaphites geinitzii d'Orbigny, 1850

Plate 10, figs. 5–7

1850 *Scaphites geinitzi* d'Orbigny, p. 214.
1959 *Scaphites geinitzi* – Najdin, p. 195, pl. 7, fig. 3.
1987 *Scaphites geinitzii* – Kaplan, Kennedy & Wright, p. 10, pl. 1, figs. 1–4, 6–10; pl. 2, figs. 1–13; pl. 3, figs. 1–5, 9–11; pl. 4, figs. 1, 2, 7; pl. 6, fig. 6.

Shell length varies in a wide range: from 22 to 25 mm (microconchs) and 48 to 60 mm (macroconchs). Whorls of spiral part of the shell are high with oval whorl section. Primaries are thin, flexuous and branched. Two or three secondaries occur between two primaries. Body chamber with flattened flanks. The inner part of shaft is straight for microconchs and swollen and convex for macroconchs. Shaft flanks bear 5–6 primaries rather thickened at the inner part of a shaft and branched into two or three ribs near the external side. Some secondaries are settled between primary ribs. All ribs cross the external side of shafts and hook without interruption. Both the edges of the external side of the body chamber are decorated by a row of tubercles settled on the primaries. Tubercles disappear in the hook beginning or near the peristome.

Comparison: Differs from *Scaphites kieslingswaldensis* Langenhan & Grundey by the longer shaft and absence of inner (near-umbilical) row of tubercles on it.

Occurrence: Upper Turonian of Crimea, Donbass, Mangyshlak, Tuarkyr, Kopetdag, Minor Caucasus, England, Germany, France, Czechia, Bulgaria, Rumania, Poland, Greenland; lower part of Lower Coniacian(?) of Germany.
Material: 3 specimens (48–49/330, 19/8104).

Genus *Hoploscaphites* Nowak, 1911

Shell with very narrow, practically closed umbilicus. High whorls with flattened or slightly convex flanks and rounded venter. Body chamber with very short shaft and slightly curved hook which is not elevated above the coiled part of the shell. Aperture angle is 110–115°. Peristome collared with preceding constriction. Sculpture

consists of thin winding primary and secondary practically equidimensional ribs. Ribs branch one or two times in pairs of the flanks and cross the venter being bending adorally. Ribbing of body chamber is non-monotonous with distinct tubercles on the external shoulder and weak umbilical tubercles or withouth them.

Maastrichtian.

Hoploscaphites constrictus (J. SOWERBY, 1817)

Plate 16, figs. 1–6

1817 *Ammonites constrictus* J. SOWERBY, p. 189, pl. 184A, fig. 1.
1974 *Hoploscaphites constrictus constrictus* – NAJDIN, p. 173, pl. 58, figs. 7–9; pl. 61, figs. 2–4.
1974 *Hoploscaphites constrictus niedzwiedzkii* – NAJDIN, p. 174, pl. 58, figs. 10, 11.
1986 *Hoploscaphites constrictus* – KENNEDY, p. 64, pl. 13, figs. 1–13, 16–24; pl. 14, figs. 1–38; pl. 15, figs. 1–31; text-figs. 9, 11A–H.
1993 *Hoploscaphites constrictus* – HANCOCK & KENNEDY, p. 166, pl. 20, figs. 1–4.
1993 *Hoploscaphites constrictus* – WARD & KENNEDY, p. 53, figs. 43.1, 43.2, 44.1–44.6, 45.3.

Various shell dimensions. Microconchs reach the diameter 20–35 mm, macroconchs 35–60 mm. Spiral part of the shell is strongly involute with almost closed umbilicus. High whorls. Flanks vary from flattened to convex. Rounded venter. 15–25 twice biplicated primaries occur on the one whorl. Secondaries are biplicated too. All ribs cross the venter without interruption bending adorally. The total number of the ribs is up to 65 per one whorl. Body chamber shaft is very short. Its height is about two times more than its length. Aperture part of the body chamber is slightly bent. Aperture angle varies from 110 to 150°. Ribs of body chamber of macroconchs are coarse bearing weak elongated in rib direction umbilical tubercles and large elongated in coiling direction tubercles settled on the external shoulder. Umbilical tubercles give rise to 2–3 ribs. On the venter of the shaft, ribs are very weak or absent at all and on the venter of aperture part ("the hook") they appear again. Tubercles occur almost up to the peristome. Ribs on the body chamber of microconchs are thinner, ventrolateral tubercles are very small and umbilical ones are rather weak or absent. Ribs cross the shaft venter without smoothing.

Comparison: Differs from *Hoploscaphites tenuistriatus* (KNER) by thinner ribbing on phragmocone and coarser ribbing on the body chamber.

Occurrence: Maastrichtian of Crimea, Caucasus, Mangyshlak, Kopetdag, Donbass, West Ukraine, France, Spain, Belgium, Netherlands, Denmark, Sweden, Austria, Bulgaria, Poland.

Material: 7 specimens (69–71/330, 26/12943, 8–10/12945).

Stratigraphical distribution of ammonites

54 species of ammonites from the Cretaceous deposits have been described by authors of the present publication. Fifteen of them have been described from the Crimea region for the first time (*Spiticeras multiforme, Gaudryceras kayei, Desmoceras inane, Desmophyllites diphylloides, Pachydiscus epiplectus, Allocrioceras strangulatum, Mariella crassituberculata, Bostrychoceras polyplocum, Diplomoceras cylindraceum, Neoglyptoxoceras retrorsum, Lechites moreti, Olcostephanus (Olcostephanus)* cf. *globosus, Thurmanniceras* cf. *pertransiens, Belbekiceras belbekii, Pseudacanthodiscus crymicus*). Extremely non-uniform distribution of fossils throughout the section does not allow the proper zonal division of the deposits and their correlation with the divisions of the International Stratigraphic Scale. However, it is possible to compare some ammonite intervals of the Crimea with those of the stratotypical areas of Europe.

The complex of the Berriasian ammonites (*Dalmasiceras, Euthymiceras, Neocosmoceras* and others) is supposed to indicate the same stratigraphic level as the upper part of the Tirnovella occitanica Zone of France and the lower part of Fauriella boissieri Zone (Dalmasiceras dalmasi and Malbosiceras paramimounum Subzones) of the Berriasian.

The Lower Valanginian ammonite *Thurmanniceras* cf. *pertransiens* (SAYN) of this assemblage allows to correlate the host deposits with the same zone of the Lower Valanginian of West Europe (BUSNARDO et al. 1979).

The upper zone of the Hauterivian, Pseudothurmannia angulicostata Zone, is proved by the findings of the ammonite *Pseudothurmannia picteti* SARCAR in South-West Crimea.

The horizon of glauconite sandstones occurring in the basal part of the Upper Cretaceous deposits in the River Belbek Basin is rather well characterized by ammonites. Most of the species occurring here are typical for the upper part of the Upper Albian (Stoliczkaia dispar Zone).

In Cenomanian sediments in the River Belbek Basin ammonites are rare. Except of *Puzosia mayoriana* authors have described only *Mantelliceras picteti*, which is typical for the Lower Cenomanian of the stratotype area and other regions of Europe and Middle Asia, and *Mesogaudryceras leptonema* which is typical for the Middle Cenomanian of England. A large number of ammonites including species shown in the present paper is identified by R. Marcinowski (Marcinowski 1980) from the basin of the River Bodrak.

From the siliccous limestones overlying the Cenomanian deposits three species (*Tongoboryceras rhodanicum*, *Allocrioceras strangulatum* and *Scaphites geinitzi*) have been described. All these species have a narrow stratigraphical distribution – the Upper Turonian, both in the Crimea and in the other regions (West Europe, Caucasus, Kopetdag).

Santonian sediments in the River Belbek Basin have been established on the basis of rare findings of *Eupachydiscus* cf. *sayni*. In South-East France this species occurs in the upper part of the Santonian.

The Lower Campanian in the discussed region is proved by findings of *Eupachydiscus levyi*. This species is characteristic for the stratotype area and for the Kopetdag. It is also known from the Lower Campanian of other regions (Caucasus, Poland, Netherlands, France, Spain).

The abundant ammonite fauna allows to establish confidently Upper Campanian and Maastrichtian deposits in the River Belbek Basin.

Parasolenoceras phaleratum is typical for the lower part of the Upper Campanian of Donbass, Germany, Austria, Poland and Afghanistan. The widely distributed species *Hauericeras fayoli*, *Pachydiscus haldemsis* and *Bostrychoceras polyplocum* characterize the Upper Campanian (mainly Bostrychoceras polyplocum Zone). *Neoglyptoxoceras retrorsum* is known from the Campanian of Europe. The cosmopolitan species *Desmophyllites diphylloides* and *Gaudryceras kayei* are known from the Santonian to the Maastrichtian, but in the Crimea they occur only together with typical Upper Campanian ammonites.

The authors have described eight species of Maastrichtian ammonites found in the River Belbek Basin, among them *Pachydiscus epiplectus*, which is a zonal species of the Lower Maastrichtian of South-West France, Austria, Caucasus and Armenia. The species *Hauericeras sulcatum* and *Psudokossmaticeras galicianum* characterize the Lower Maastrichtian and *Pachydiscus gollevillensis* the Upper Maastrichtian of Europe.

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Explanation of plates

Plate 1

Figs. 1–3. *Dalmasiceras crassicostatum* (DJANELIDZE); 1 – 1/330, side view, life-size; 2 – 2/330: a – ventral view, b – side view, life-size; 3 – 3/330, side view, life-size; South-West Crimea, Belbek River, Berriasian.

Figs. 4–5. *Dalmasiceras* aff. *crassicostatum* (DJANELIDZE); 4 – 5/330: a – oral view, b – ventral view, c – side view, life-size; 5 – 6/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Plate 2

Figs. 1–2. *Dalmasiceras* aff. *crassicostatum* (DJANELIDZE); 1 – 7/330: a – side view, b – ventral view, life-size; 2 – 8/330: a – oral view, b – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 3. *Dalmasiceras* sp., 10/330: a – side view, b – oral view, c – ventral view, life-size; South-West Crimea, Belbek River, Kabanii Ravine, Berriasian.

Fig. 4. *Biasaloceras liebigi* (OPPEL), 11/330: b – ventral view, a – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 5. *Protetragonites tauricus* (KULJINSKAIA-VORONETZ), 12/330: side view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 6. *Haploceras* ex gr. *elimatum* (OPPEL), 14/330: a – ventral view, b – side view, c – oral view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 7. *Ptychophylloceras ptychoicum* (QUENSTEDT), 15/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Plate 3

Fig. 1. *Spiticeras multiforme* DJANELIDZE, 17/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 2. *Spiticeras orientale* (KILIAN), 18/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Fig. 3. *Spiticeras obliquelobatum* (UHLIG), 19/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Berriasian.

Figs. 4–5. *Malbosiceras (?)* sp.; 4 – 20/330, side view, life-size; South-West Crimea, Belbek River, Berriasian; 5 – 14/12943: a – oral view, b – side view, life-size; Central Crimea, Sarysu River Basin, Enisaray Ravine, Berriasian.

Fig. 6. *Macrophylloceras ptychostoma* (BENECKE), 21/330: a – side view, b – oral view, c – ventral view, life-size; South-West Crimea, Belbek River, Berriasian.

Plate 4

Fig. 1. *Pseudothurmannia picteti* (SARCAR), 22/330: a – ventral view, b – side view, c – oral view, life-size; South-West Crimea, Kacha River Basin, village of Vysokoe, Upper Hauterivian.

Figs. 2–5. *Euthymiceras (?)* ex gr. *euthymi* (PICTET); 2 – 23/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Berriasian; 3 – 1/12943, side view, life-size; 4 – 2/12943, side view, life-size; 5 – 3/12943, side view, life-size; Central Crimea, Sarysu River Basin, village of Balki, Berriasian.

Fig. 6. *Neocosmoceras* sp., 24/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Kabanii Ravine, Berriasian.

Plate 5

Fig. 1. *Belbekiceras belbekii* BARABOSCHKIN, 94/1 (holotype): a – oral view, b – side view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Fig. 2. *Thurmanniceras* sp., 94/4, fragment of the phragmocone: a – side view, b – ventral view; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Figs. 3–4. *Thurmanniceras* cf. *pertransiens* (Sayn); 3 – 94/2, side view (× 0.5); 4 – 94/3: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Fig. 5. *Olcostephanus (Olcostephanus)* cf. *globosus* Spath, 94/5: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Fig. 6. *Ptychophylloceras ptychoicum* (Quenstedt), 94/6: a – side view, b – oral view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Fig. 7. *Neolissoceras grasianum* (d'Orbigny), 94/7: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Figs. 8–9. *Pseudacanthodiscus crymicus* Baraboschkin; 8 – 94/8 (holotype): a – ventral view, b – side view, life-size; 9 – 94/9: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Sbrosovyi Ravine, Lower Valanginian.

Plate 6

Figs. 1–4. *Puzosia mayoriana* (d'Orbigny), 1 – 25/330, side view, life-size; South-West Crimea, Belbek River, Upper Albian; 2 – 26/330: a – oral view, b – side view, life-size; South-West Crimea, Belbek River, Mokryi Brook, Upper Albian; 3 – 27/330, side view, life-size; South-West Crimea, Belbek River, Cenomanian; 4 – 6/12944, side view, life-size; Armenia, Idzhevanskii Range, Upper Albian, Stoliczkaia (Faraudiella) blancheti Zone.

Fig. 5. *Anapuzosia naidini* Marcinowski, 30/330: a – ventral view (x 0.5), b – side view (x 0.5); South-West Crimea, Belbek River, Upper Albian.

Plate 7

Fig. 1. *Lechites moreti* Breistroffer, 31/330, ventral view, life-size; South-West Crimea, Belbek River, Mokryi Brook, Upper Albian.

Figs. 2–3. *Hamites virgulatus* Brongniart; 2 – 32/330, side view, life-size; South-West Crimea, Belbek River, Dusina Mountain, Upper Albian; 3 – 33/330, side view, life-size; South-West Crimea, Belbek River, Mokryi Brook, Upper Albian.

Figs. 4–7. *Mariella bergeri* (Brongniart); 4 – 34/330, side view, life-size; South-West Crimea, Belbek River, Sukhoi Ravine, Upper Albian; 5 – 39/9431, side view, life-size; Tuarkyr, Koimat Range, Upper Albian, upper part of Stoliczkaia dispar Zone; 6 – 197/9431: a – side view, b – upper view, life-size; West Kopetdag, Kamyshly Canyon, Upper Albian, Stoliczkaia dispar Zone; 7 – 120/9431: a – side view (× 2), b – lower view (× 2); West Kopetdag, upper reaches of the Aydere River, Sovutly Canyon, Upper Albian, Stoliczkaia dispar Zone.

Fig. 8. *Mariella crassituberculata* Spath, 35/330, side view, life-size; South-West Crimea, Belbek River, Sukhoi Ravine, Upper Albian.

Figs. 9–12. *Ostlingoceras puzosianum* (d'Orbigny); 9 – 123/9431: a – side view, b – lower view, life-size; West Kopetdag, upper reaches of the Aydere River, Sovutly Canyon, Upper Albian, Stoliczkaia dispar Zone; 10 – 36/330, side view, life-size; South-West Crimea, Belbek River, mouth of Sukhoi Ravine, Upper Albian; 11 – 37/330, side view, life-size; South-West Crimea, Belbek River, mouth of Sukhoi Ravine, Upper Albian; 12 – 124/9431, side view (× 1.5); West Kopetdag, upper reaches of the Aydere River, Sovutly Canyon, Upper Albian, Stoliczkaia dispar Zone.

Figs. 13–14. *Anisoceras perarmatum* Pictet & Campiche; 13 – 29/12944: a – side view, b – ventral view, life-size; Armenia, southern slope of Idzhevanskii Range, Upper Albian, Stoliczkaia dispar Zone; 14 – 39/330: a – ventral view, b – cross section, c – side view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Albian.

Plate 8

Figs. 1–2. *Mortoniceras rostratum* (J. Sowerby); 1 – 40/330: a – ventral view (× 0.7), b – side view (× 0.7); South-West Crimea, Belbek River, Upper Albian; 2 – 26/12944; a – oral view, b – ventral view, c – side view, life-size; Armenia, southern slope of Idshevanskii Range, Upper Albian, Stoliczkaia dispar Zone.

Plate 9

Fig. 1. *Mortoniceras* cf. *perinflatum* Spath, 41/330: a – side view, b – ventral view, life-size; Crimea, Bodrak River, Upper Albian.

Fig. 2. *Desmoceras inane* (Stoliczka), 42/330: a – oral view, b – side view, c – ventral view, life-size; South-West Crimea, Belbek River, Mokryi Brook, Upper Albian.

Figs. 3–5. *Desmoceras latidorsatum* (Michelin); 3 – 43/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Mokryi Brook, Upper Albian; 4 – 3/12945: a – side view, b – oral view, c – ventral view, life-size; d, e, f – by analogy (× 1.5); West Kopetdag, Chalsu Canyon, lower part of the Middle Cenomanian, Cunningtoniceras cunningtoni Zone; 5 – 2/12945: a – oral view, b – ventral view, c – side view, life-size; d, e, f – by analogy (× 2), g – lobe line (× 3); Bolshoy Balkhan, Koshagir Range, upper part of the Lower Cenomanian, Mantelliceras dixoni Zone.

Plate 10

Figs. 1–2. *Mesogaudryceras leptonema* (Sharpe); 1 – 44/330, side view, life-size; South-West Crimea, Belbek River, Sukhoi Ravine, Cenomanian; 2 – 45/330, side view, life-size; South-West Crimea, Belbek River, Dusina Mountain, Middle Cenomanian.

Fig. 3. *Allocrioceras strangulatum* Wright, 46/330, side view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian.

Fig. 4. *Mantelliceras pictet*i Hyatt, 47/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Lower Cenomanian.

Figs. 5–7. *Scaphites geinitzii* d'Orbigny; 5 – 19/8104: a – ventral view, b – side view, life-size; Mangyshlak, Upper Turonian; 6 – 48/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian; 7 – 49/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian.

Figs. 8–11. *Tongoboryceras rhodanicum* (Roman & Mazeran); 8 – 50/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian; 9 – 51/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian; 10 – 52/330, side view, life-size; South-West Crimea, Belbek River, Cenomanian Range, Upper Turonian; 11 – 7/12945: a – ventral view, b – side view, c – oral view, life-size; Maly Balkhan, Chalsu Canyon, Upper Turonian, Subprionocyclus neptuni Zone.

Fig. 12. *Eupachydiscus* cf. *sayni* (de Grossouvre), 53/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Polus Mountain, Upper Santonian.

Plate 11

Fig. 1. *Gaudryceras kayei* (Forbes), 54/330, side view, life-size; South-West Crimea, Belbek River, Ulyanovski Ravine, Upper Campanian.

Fig. 2. *Neoglyptoxoceras retrorsum* (Schluter), 55/330, side view, life-size; South-West Crimea, Belbek River, Upper Campanian.

Figs. 3–5. *Eupachydiscus levyi* (de Grossouvre); 3 – 10/12945, side view, life-size; West Kopetdat, Sekizkhan Canyon, upper part of the Lower Campanian, Eupachydiscus levyi Zone; 4 – 56/330, imprint, side view, life-size; South-West Crimea, Belbek River, Lower Campanian; 5 – 7/8304: a – side view, b – ventral view, life-size; West Kopetdag, Kuylyar Mountain, upper part of the Lower Campanian, Eupachydiscus levyi Zone.

Plate 12

Fig. 1. *Desmophyllites diphylloides* (Forbes), 57/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, White Range, Upper Campanian.

Fig. 2. *Parasolenoceras* cf. *phaleratum* (Griepenkerl), 58/330: a – side view, b – inner view, life-size; South-West Crimea, Belbek River, Upper Campanian.

Figs. 3–5. *Bostrychoceras polyplocum* (Roemer); 3 – 24/12945, side view, life-size; West Kopetdag, Chalsu Canyon, Upper Campanian, Bostrychoceras polyplocum Zone; 4 – 8/9391, side view, life-size; West Kopetdat, Seitkerderi Mountain, Upper Campanian, Bostrychoceras polyplocum Zone; 5 – 59/330, side view, life-size; South-West Crimea, Belbek River, Upper Campanian, Bostrychoceras polyplocum Zone.

Fig. 6. *Hauericeras fayoli* de Grossouvre, 20/12943, side view, life-size; South-West Crimea, Belbek River, Upper Campanian.

Fig. 7. *Hauericeras sulcatum* (Kner), 60/330, side view, life-size; South-West Crimea, Belbek River, "Daman" cuesta, Lower Maastrichtian.

Fig. 8. *Phylloceras (Neophylloceras) surya* Forbes, 1/12946, side view, life-size; North Caucasus, Dagestan, village of Aymaki, Lower Maastrichtian.

Plate 13

Figs. 1–3. *Pachydiscus haldemsis* (Schluter); 1 – 61/330: a – oral view (x 0.5), b – side view (x 0.5); South-West Crimea, Belbek River, White Range, Upper Campanian; 2 – 62/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, White Range, Upper Campanian; 3 – 63/330: a – side view, b – oral view, life-size; South-West Crimea, White Range, Upper Campanian.

Fig. 4. *Pachydiscus gollevillensis* (d'Orbigny), 22/12943: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, Upper Maastrichtian.

Plate 14

Figs. 1–2. *Pachydiscus neubergicus* (von Hauer); 1 – 21/12943: a – side view, b – oral view, life-size; South-West Crimea, Chufut-Kale Range, Maastrichtian; 2 – 65/330: a – side view, b – ventral view, life-size; South-West Crimea, Belbek River, "Daman" cuesta, upper part of the Lower Maastrichtian.

Fig. 3. *Pachydiscus epiplectus* (Redtenbacher), 66/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, upper part of the Lower Maastrichtian.

Plate 15

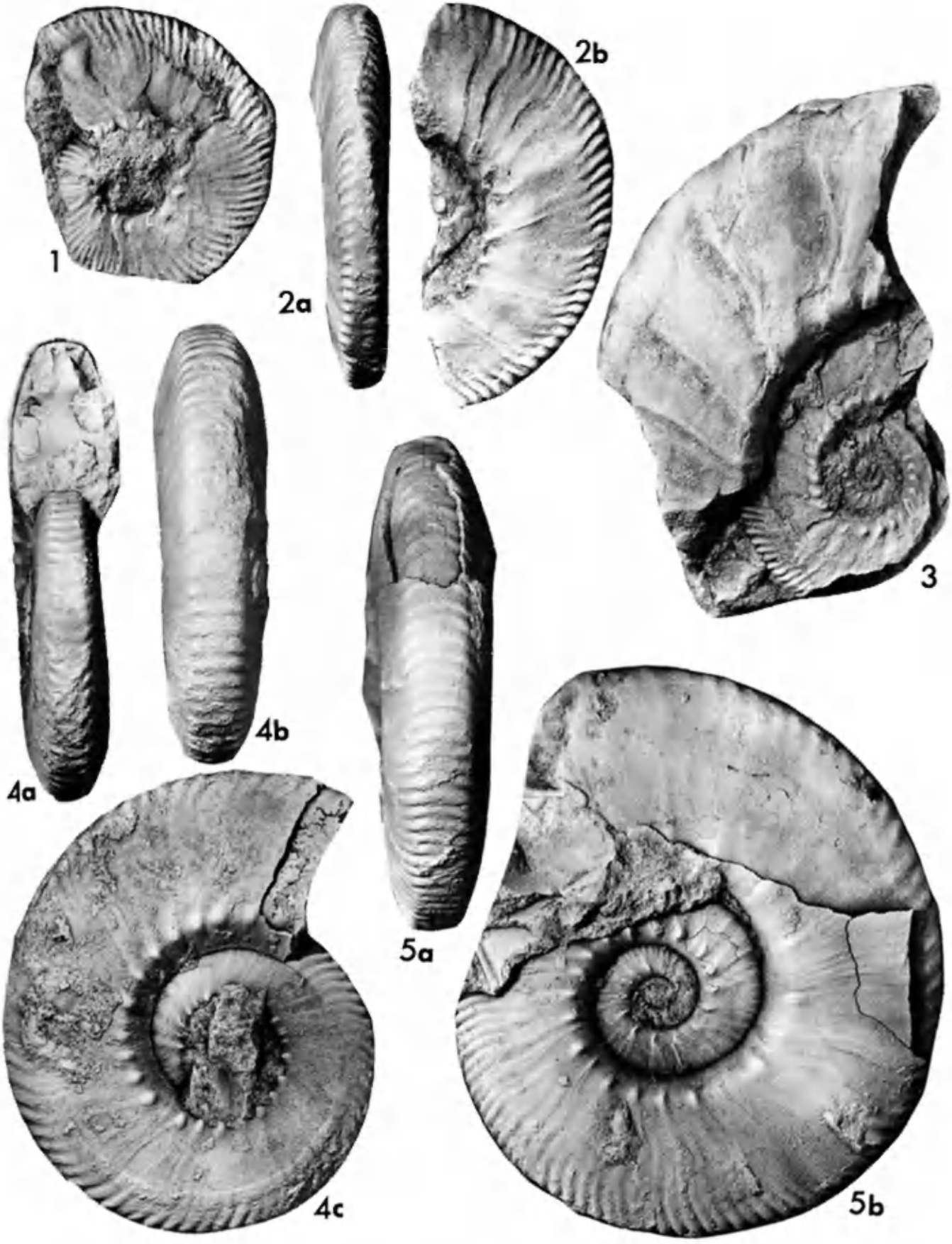
Fig. 1. *Diplomoceras cylindraceum* (Defrance), 38/12944: a – ventral (siphonal) view, b – inner (antisiphonal) view, c – side view, life-size; Armenia, Egeknadzorskii region, village of Areni, Maastrichtian.

Figs. 2–4. *Pseudokossmaticeras galicianum* (Favre); 2 – 68/330: a – ventral view, b – side view, life-size; South-West Crimea, Belbek River, village of Malo-Sadovoe, Lower Maastrichtian; 3 – 6/12945: a – side view, b – ventral view, life-size; West Kopetdag, Kredin Canyon, Lower Maastrichtian, Hauericeras sulcatum Zone; 4 – 2/12946: a – ventral view, b – side view, life-size; North Caucasus, left bank of the Chanty Argun River, Lower Maastrichtian, Nostoceras hyatti Zone.

Plate 16

Fig. 1–6. *Haploscaphites constrictus* (J. Sowerby); 1 – 69/330, side view, life-size; Crimea, Ak-kaya Mountain, Lower Maastrichtian; 2 – 70/330, side view, life-size; Crimea Ak-kaya Mountain, Lower Maastrichtian; 3 – 71/330, side view, life-size; South-West Crimea, Belbek River, village of Malo-Sadovoc, "Danian" cuesta, Lower Maastrichtian; 4 – 32/12945, side view, life-size; West Kopetdag, left bank of the Sumbar River, Isak Mountain, upper part of the Lower Maastrichtian; 5 – 31/12945: a – ventral view, b – side view, life-size; West Kopetdag, Ayshem Mountain, upper part of the Lower Maastrichtian; 6 – 30/12945, side view, life-size; West Kopetdag, Seitkerderi Mountain, Upper Maastrichtian.

Figs. 7–8. *Diplomoceras cylindraceum* (Defrance); 7 – 67/330: a – side view, b – ventral (siphonal) view, life-size; South-West Crimea, Belbek River, "Danian" cuesta, Lower Maastrichtian; 8 – 23/12943: a, c – side view, b – inner (antisiphonal) view, life-size; Crimea, Ak-kaya Mountain, Maastrichtian.



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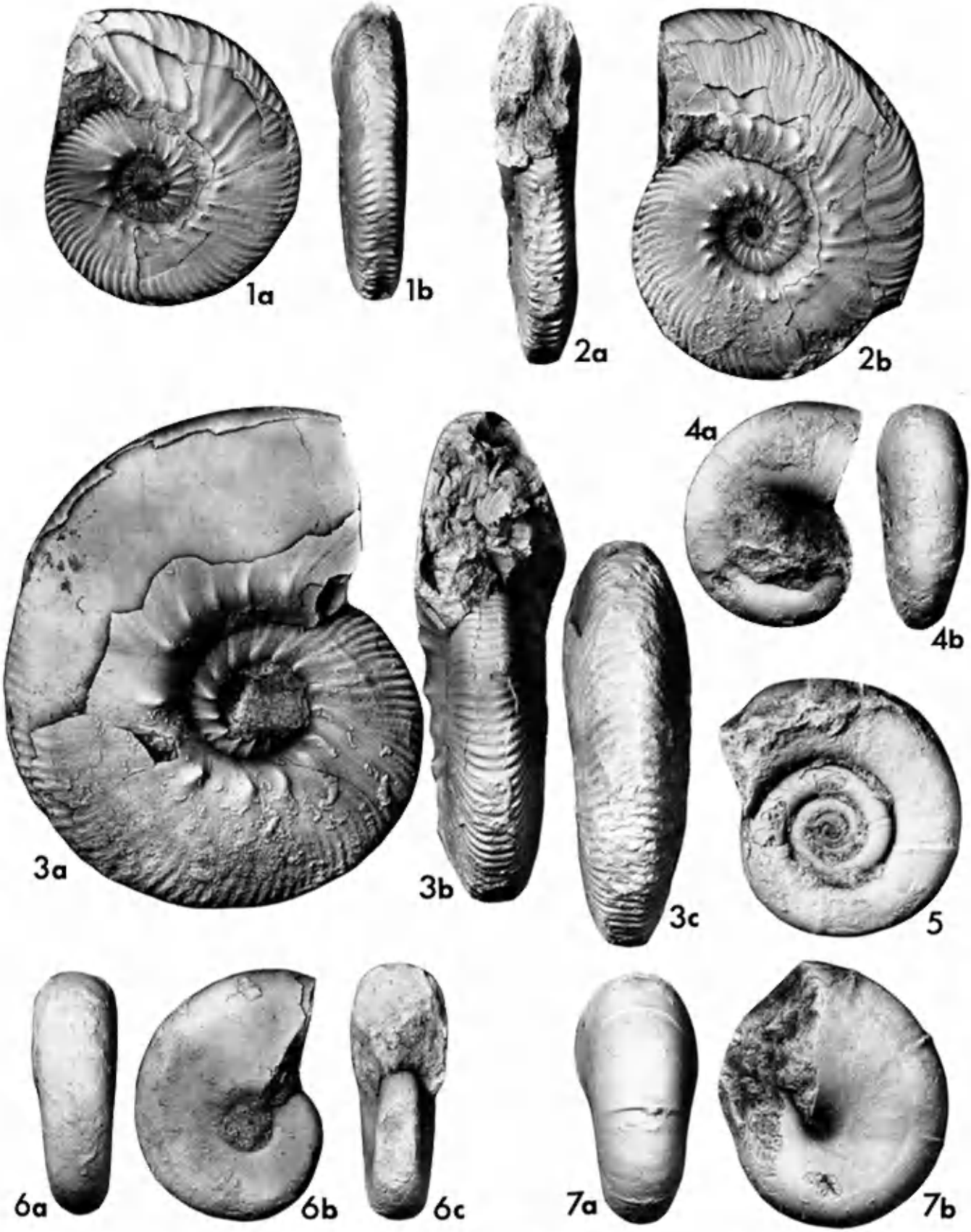

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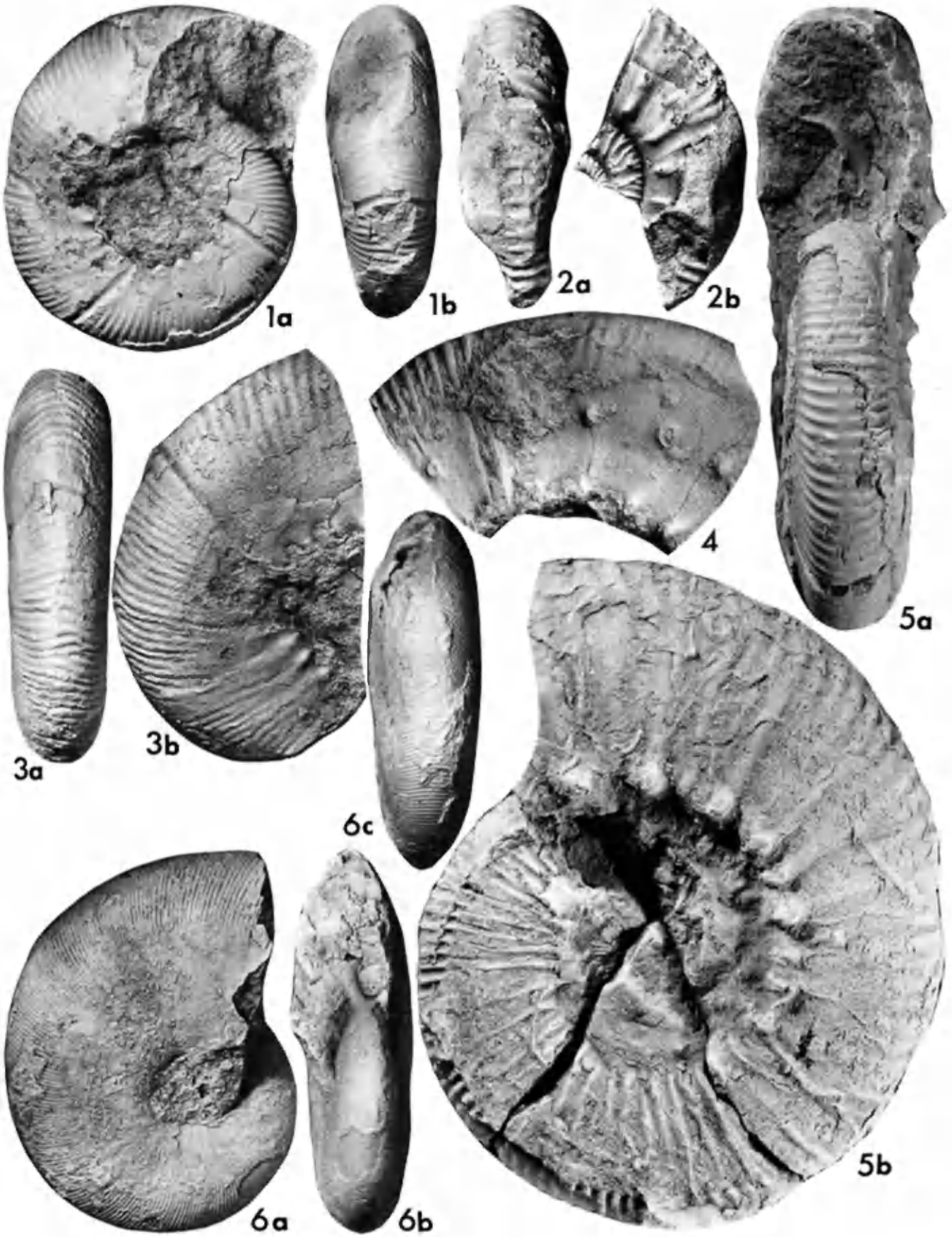

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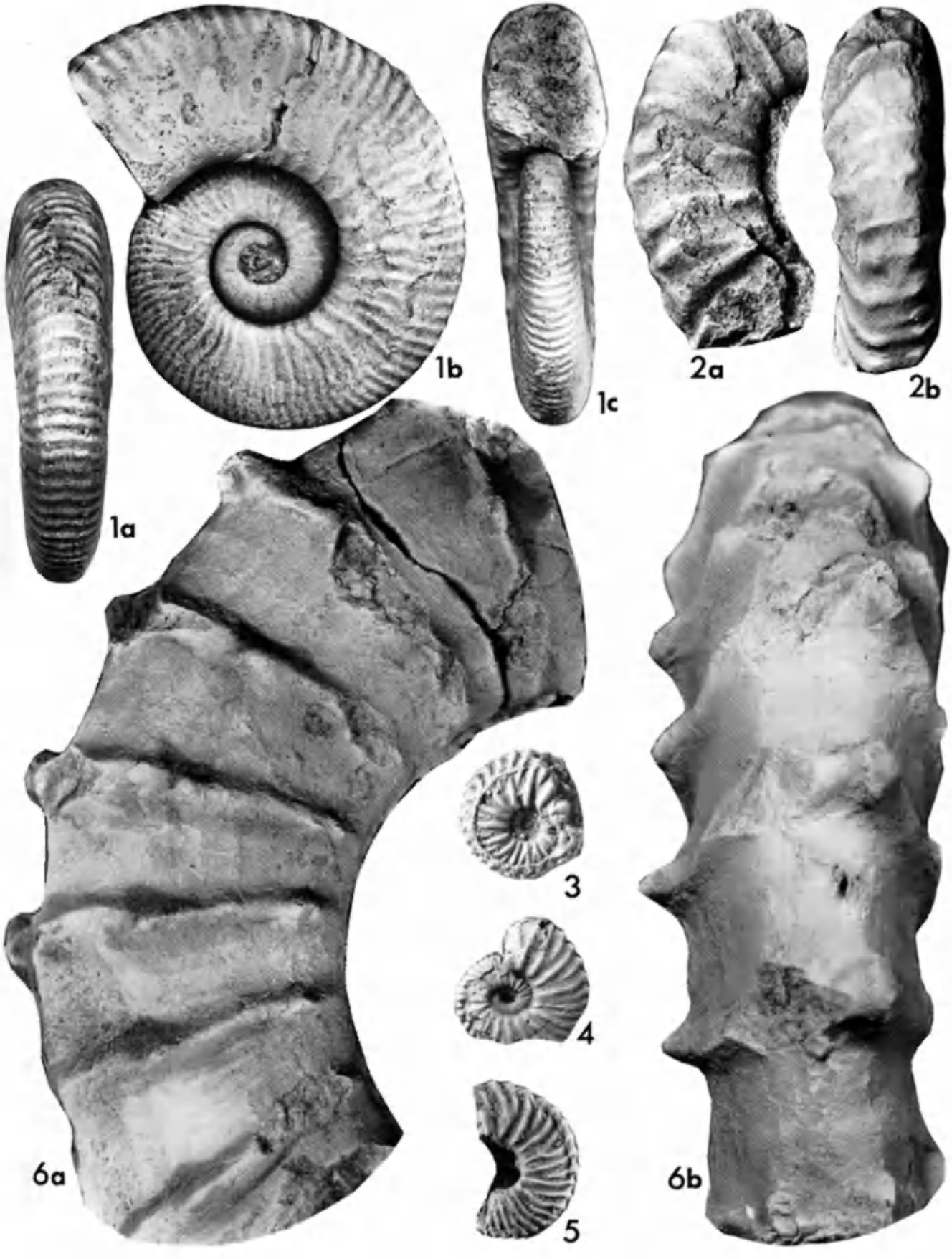

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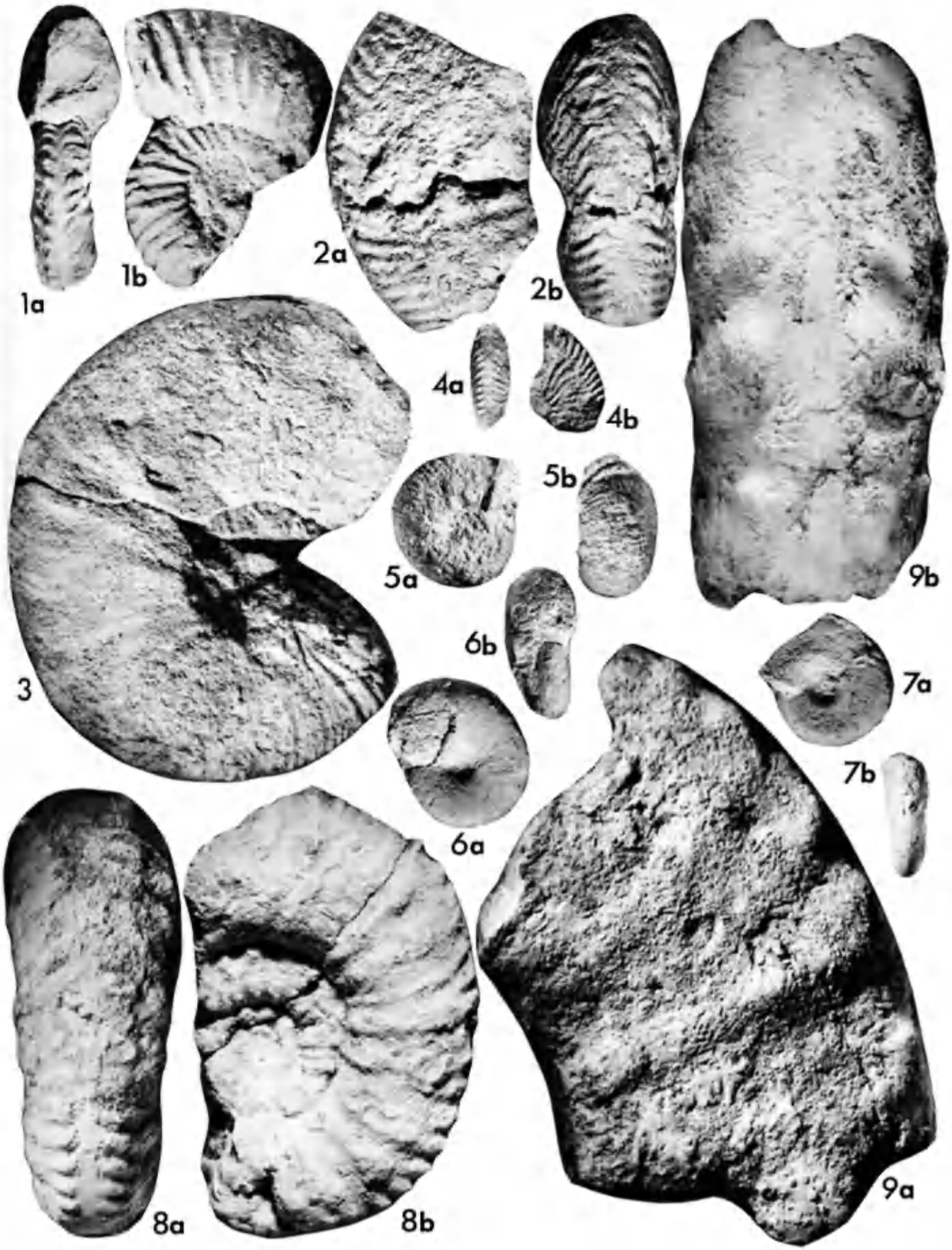

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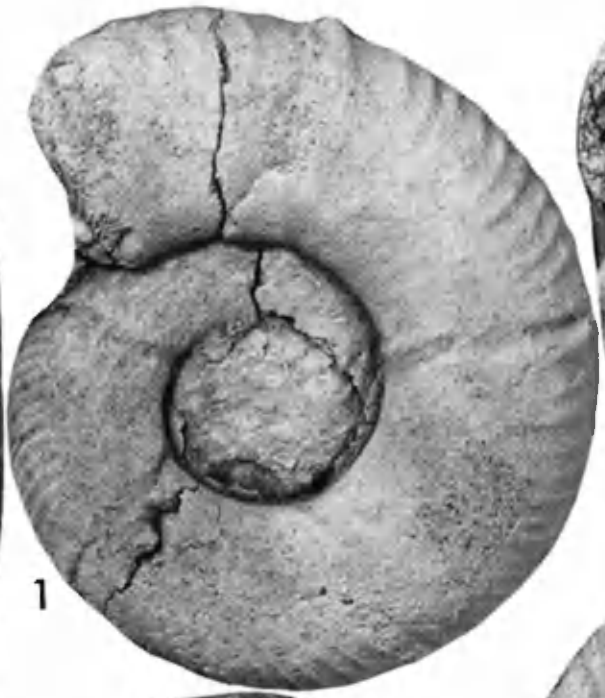

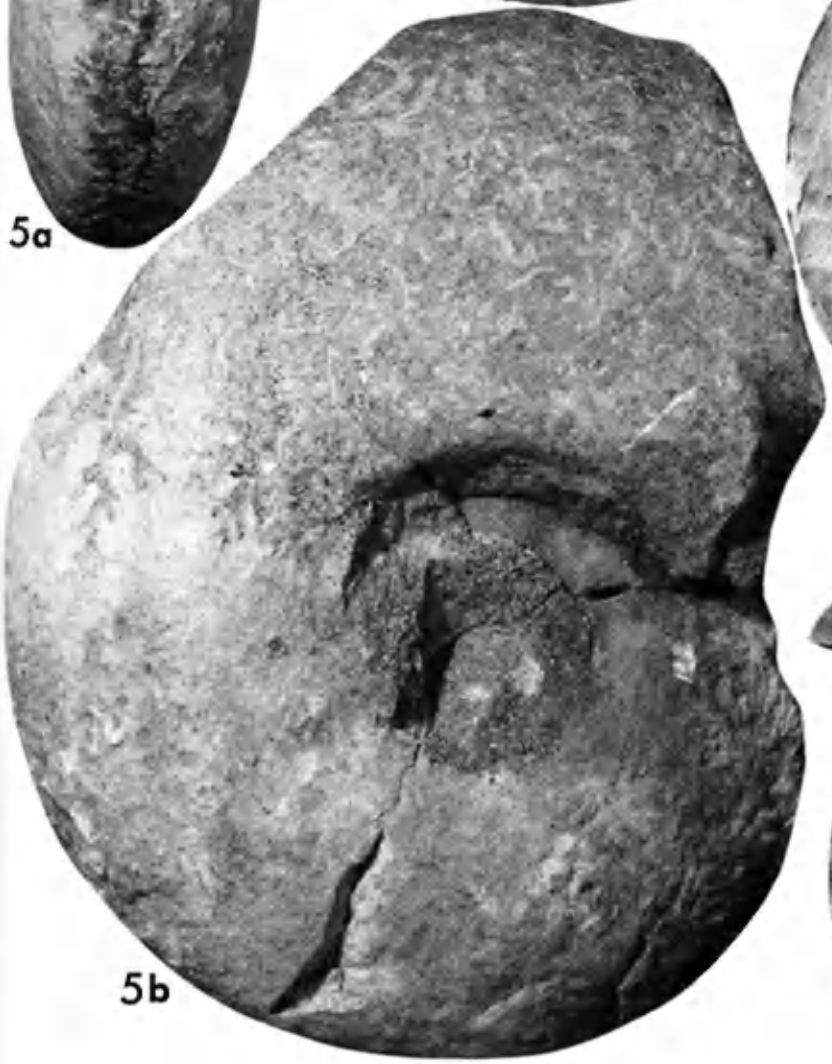

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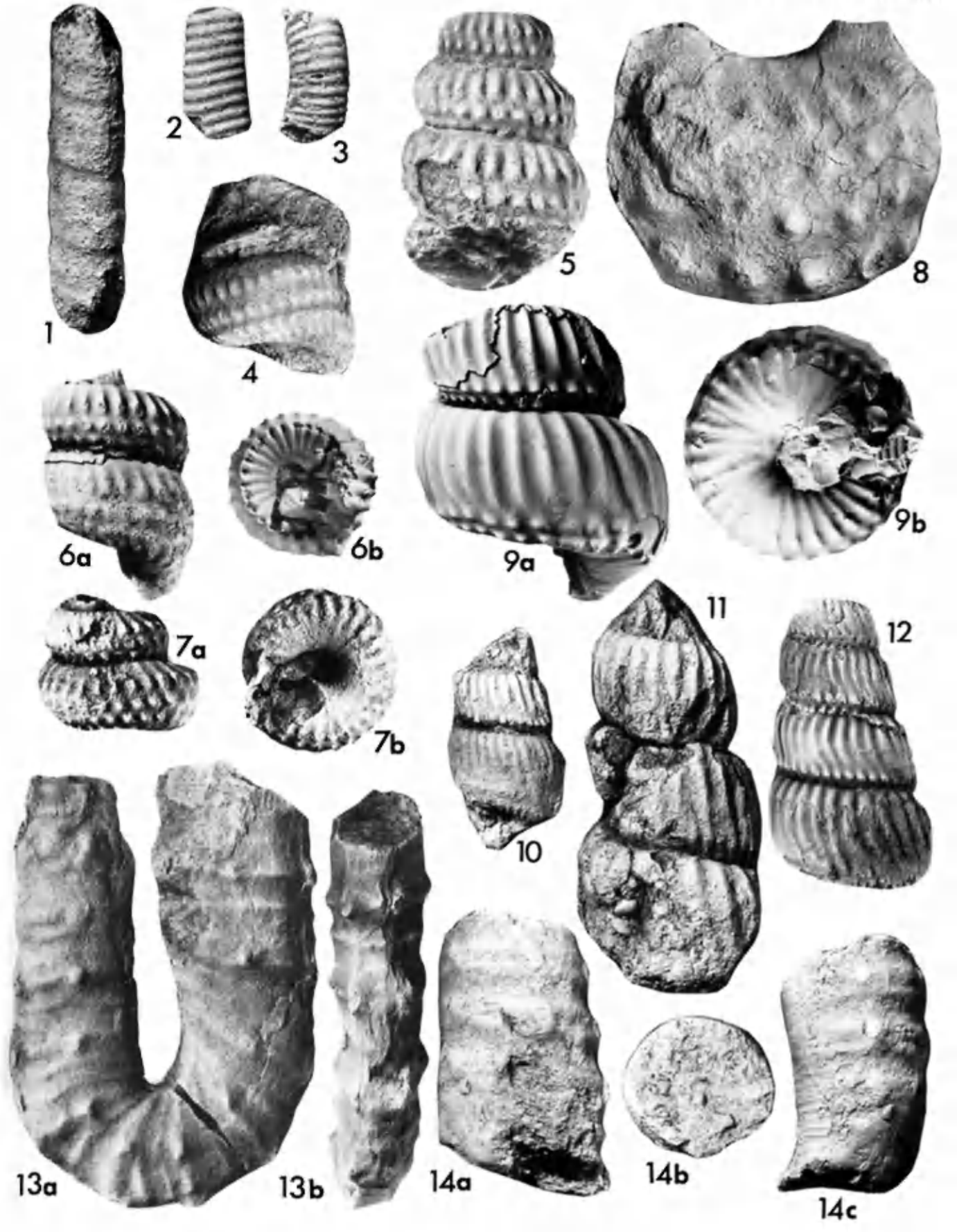

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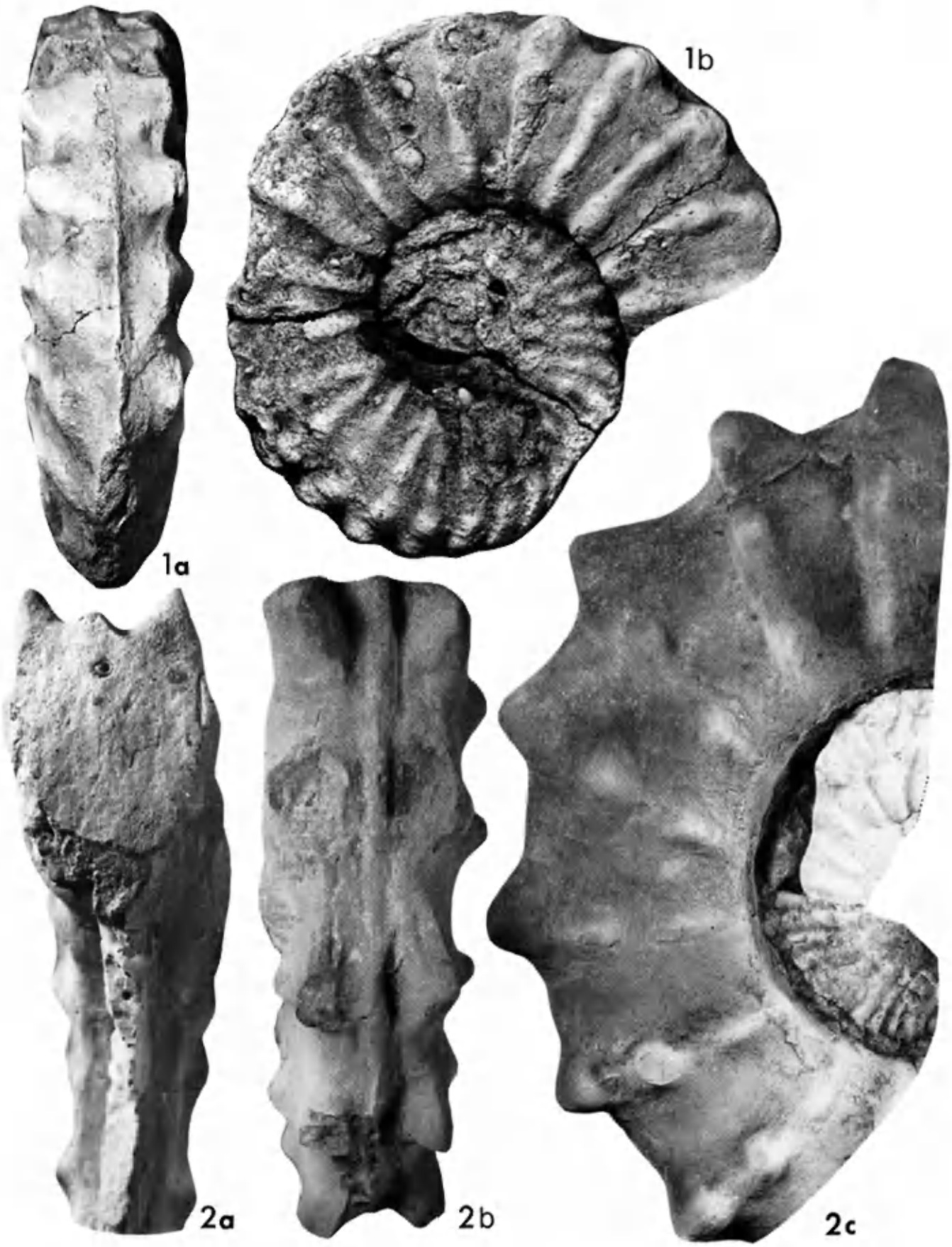

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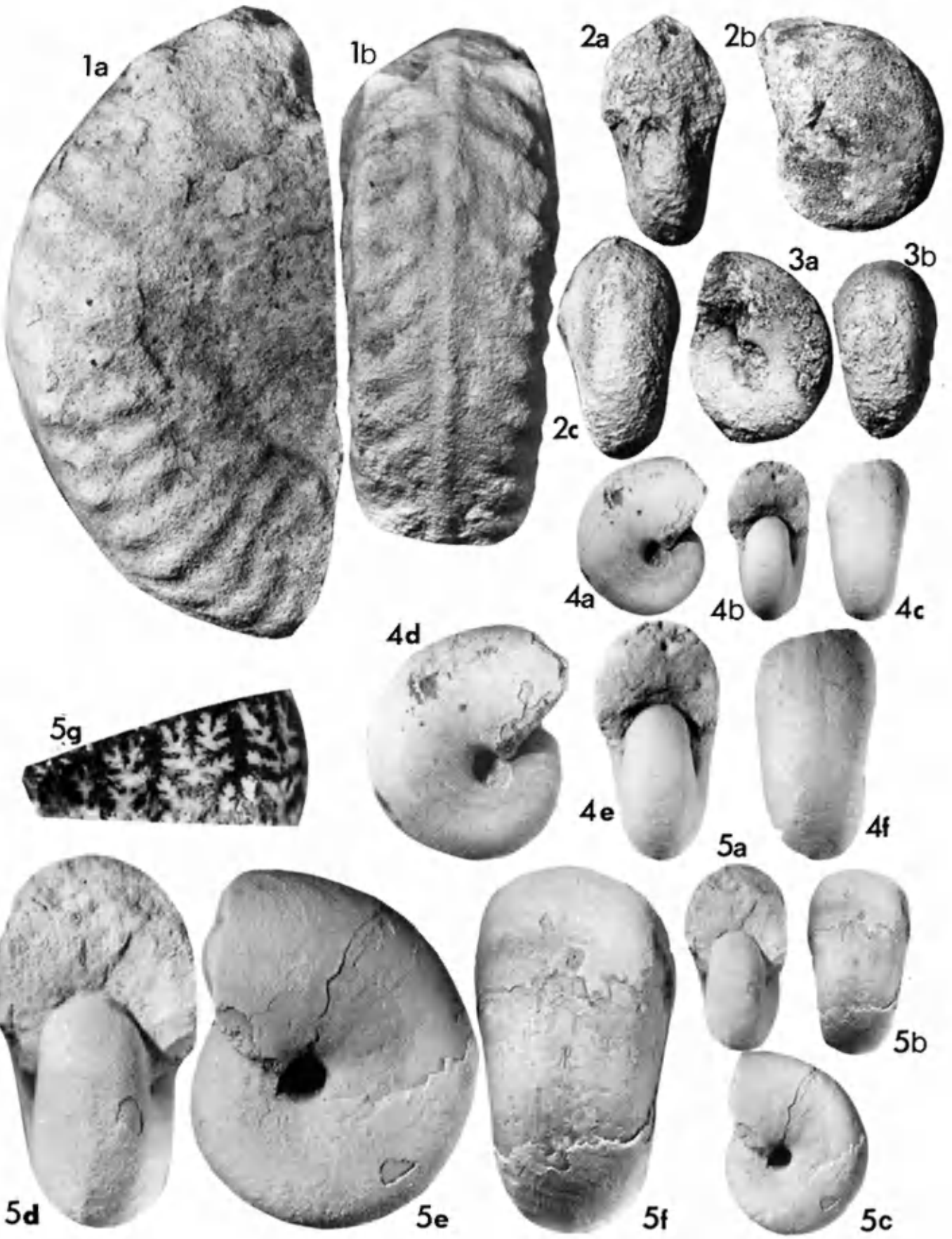

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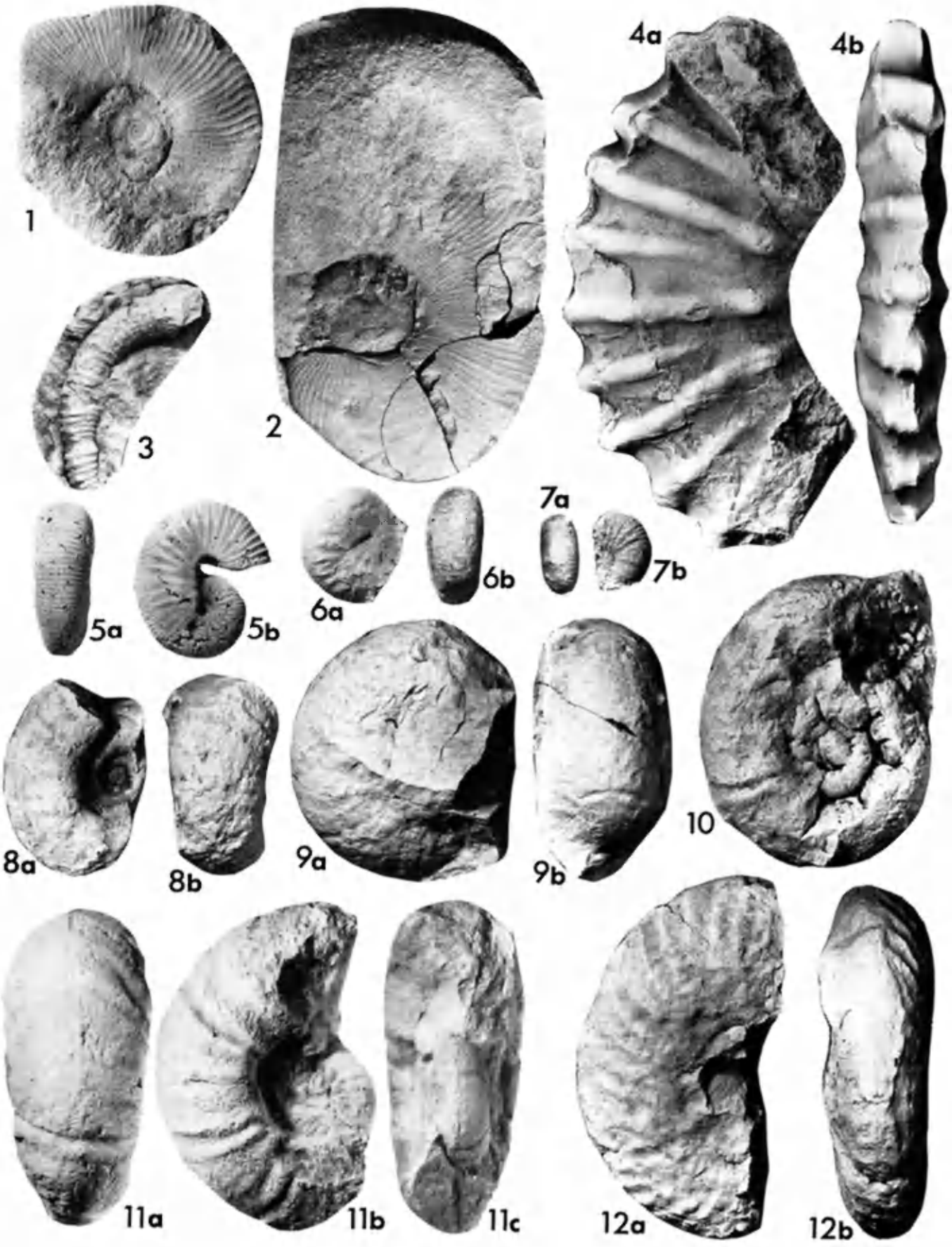

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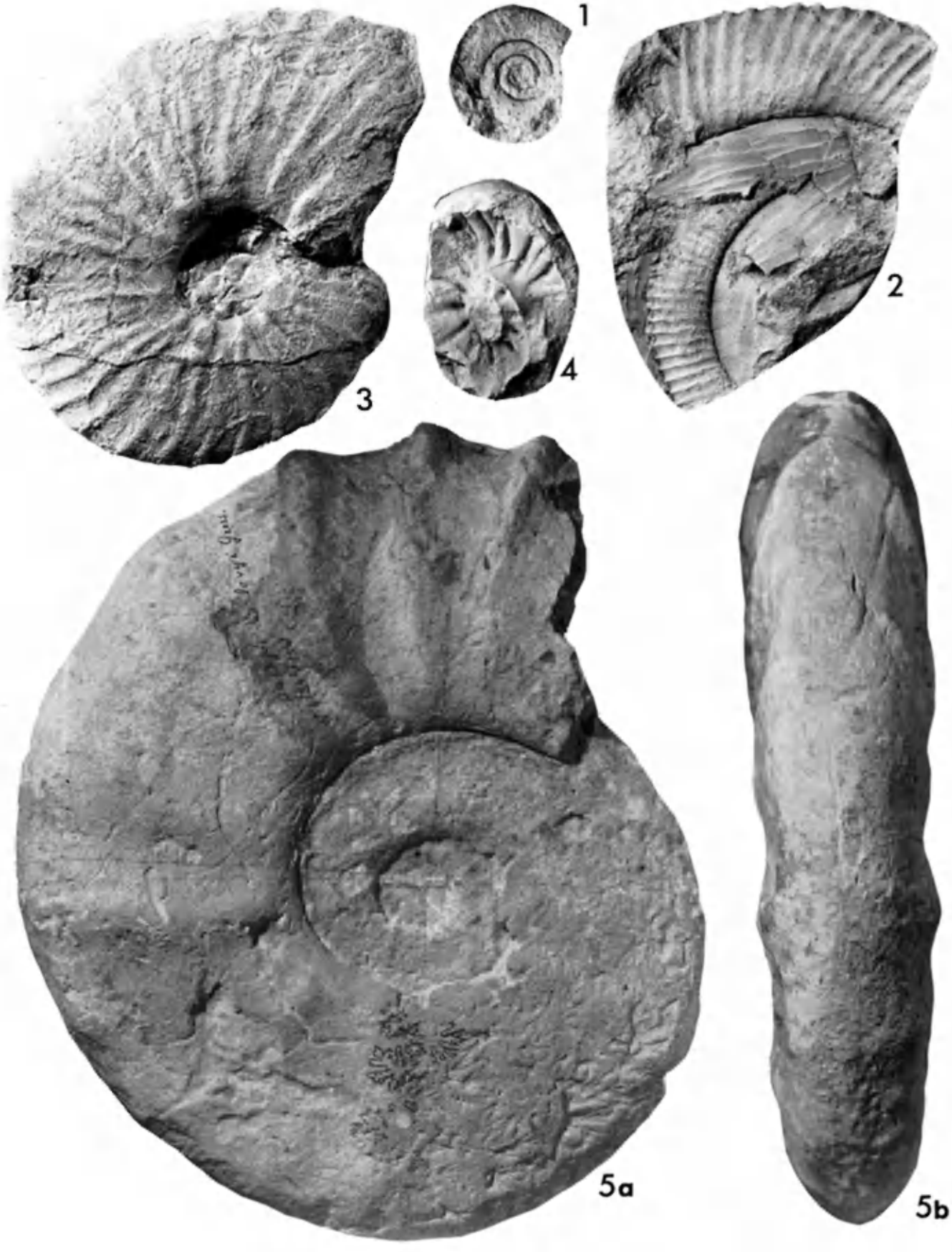

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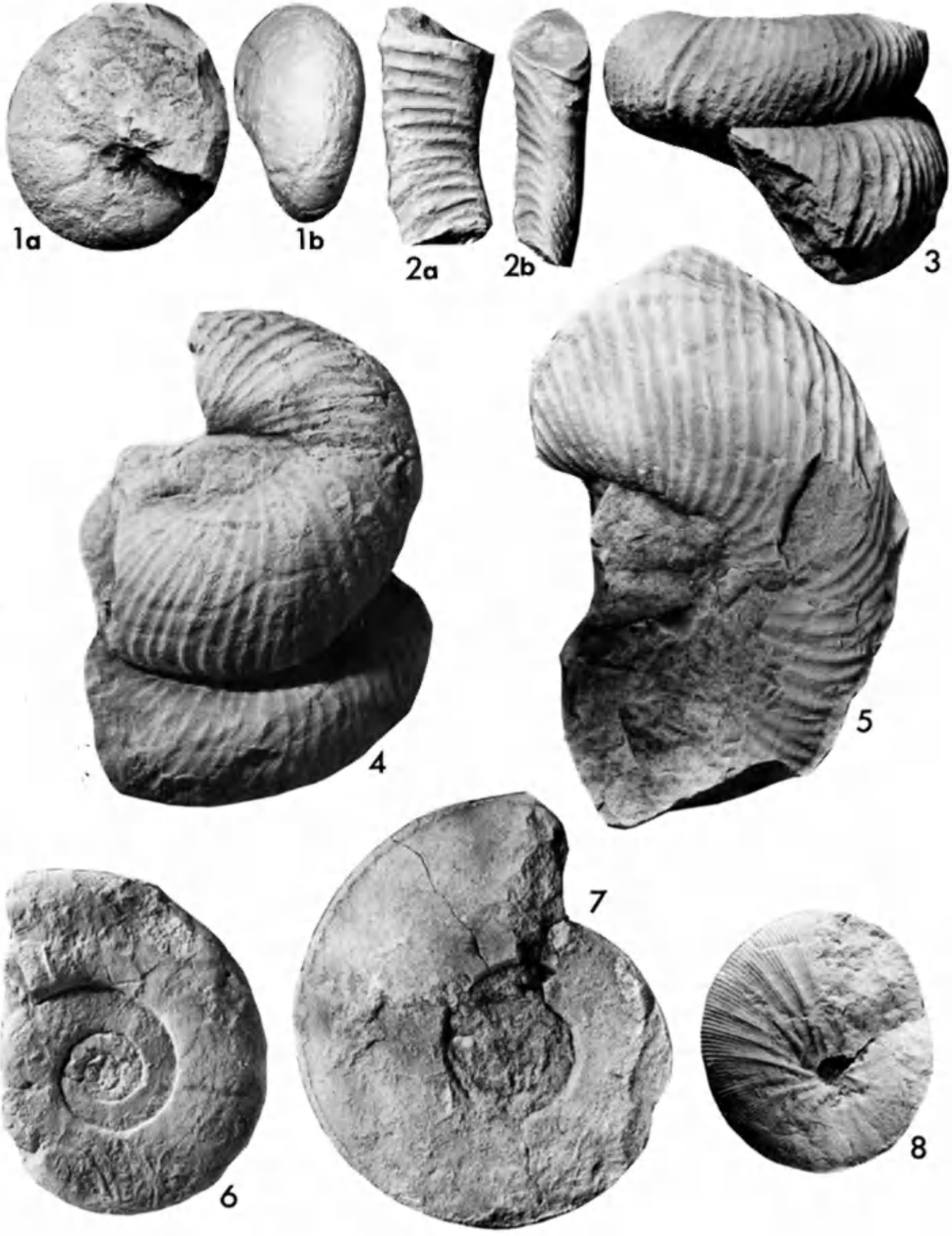

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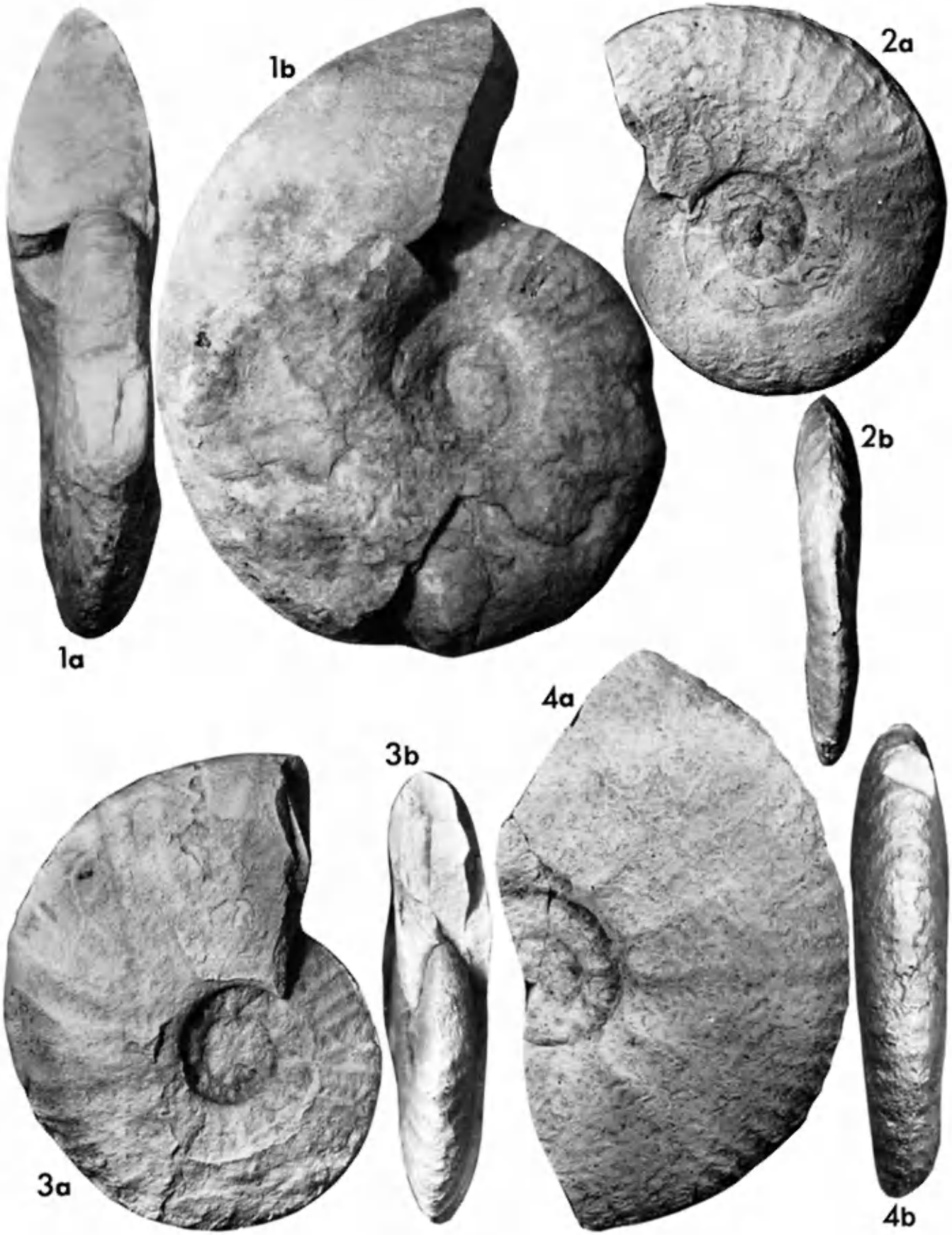

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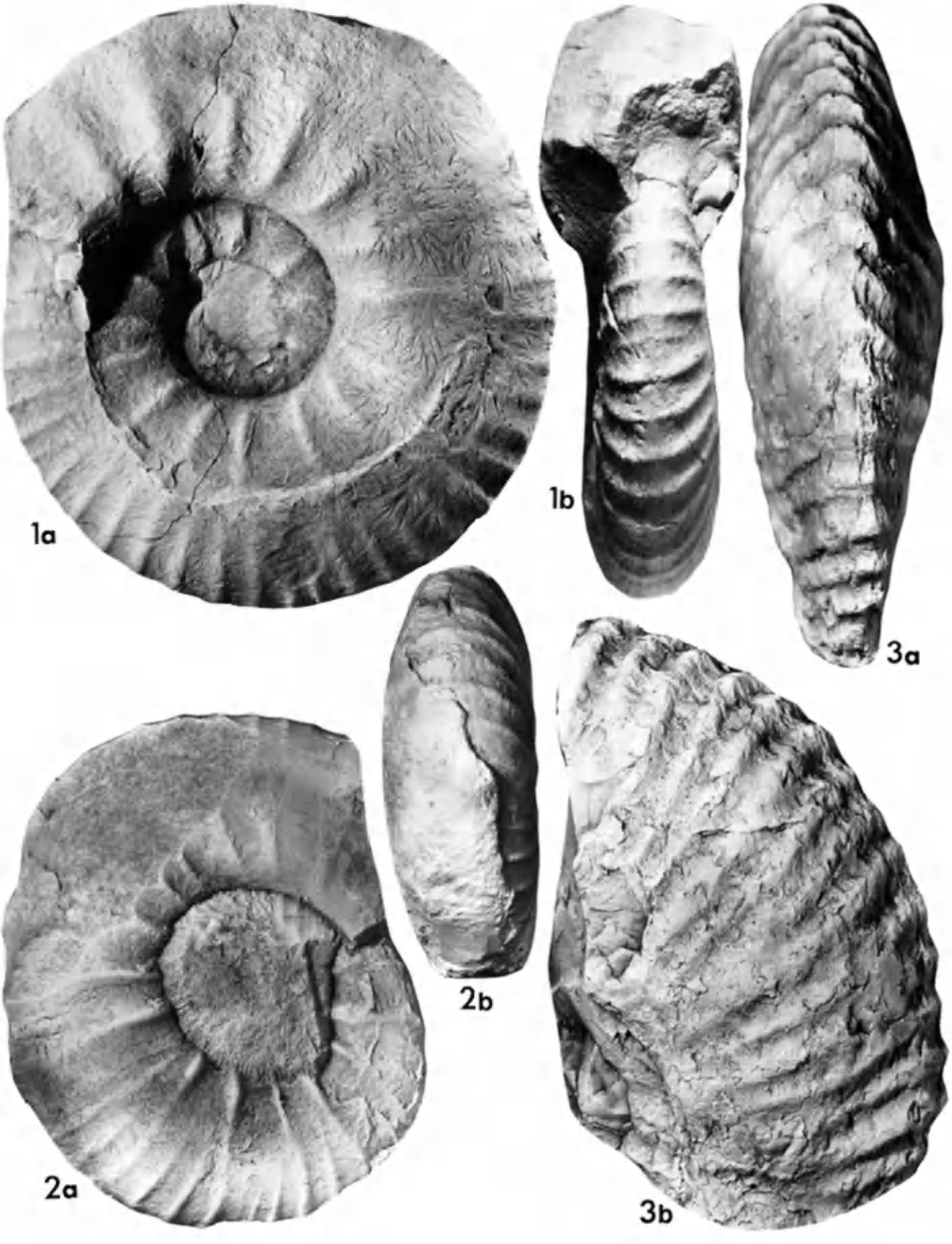

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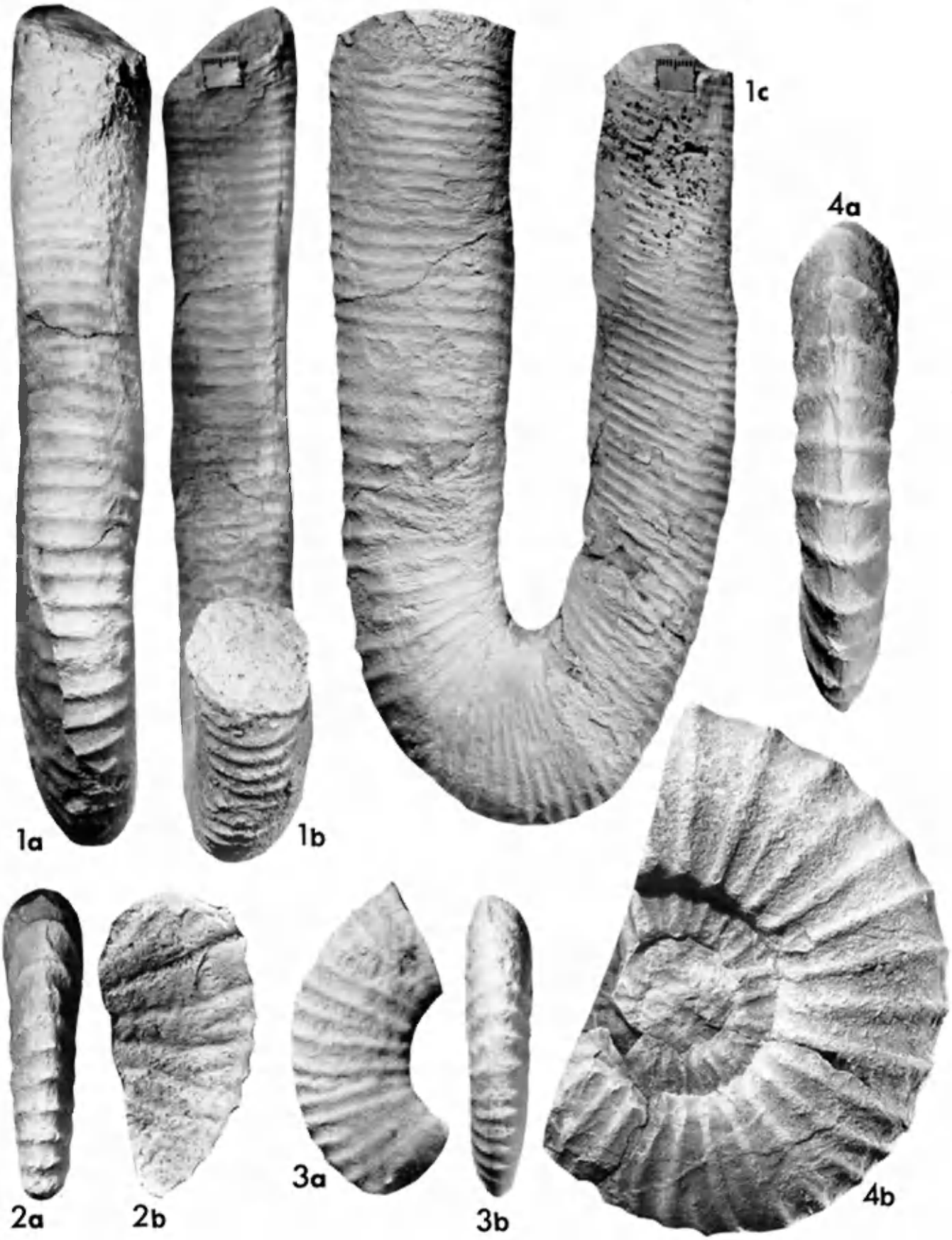

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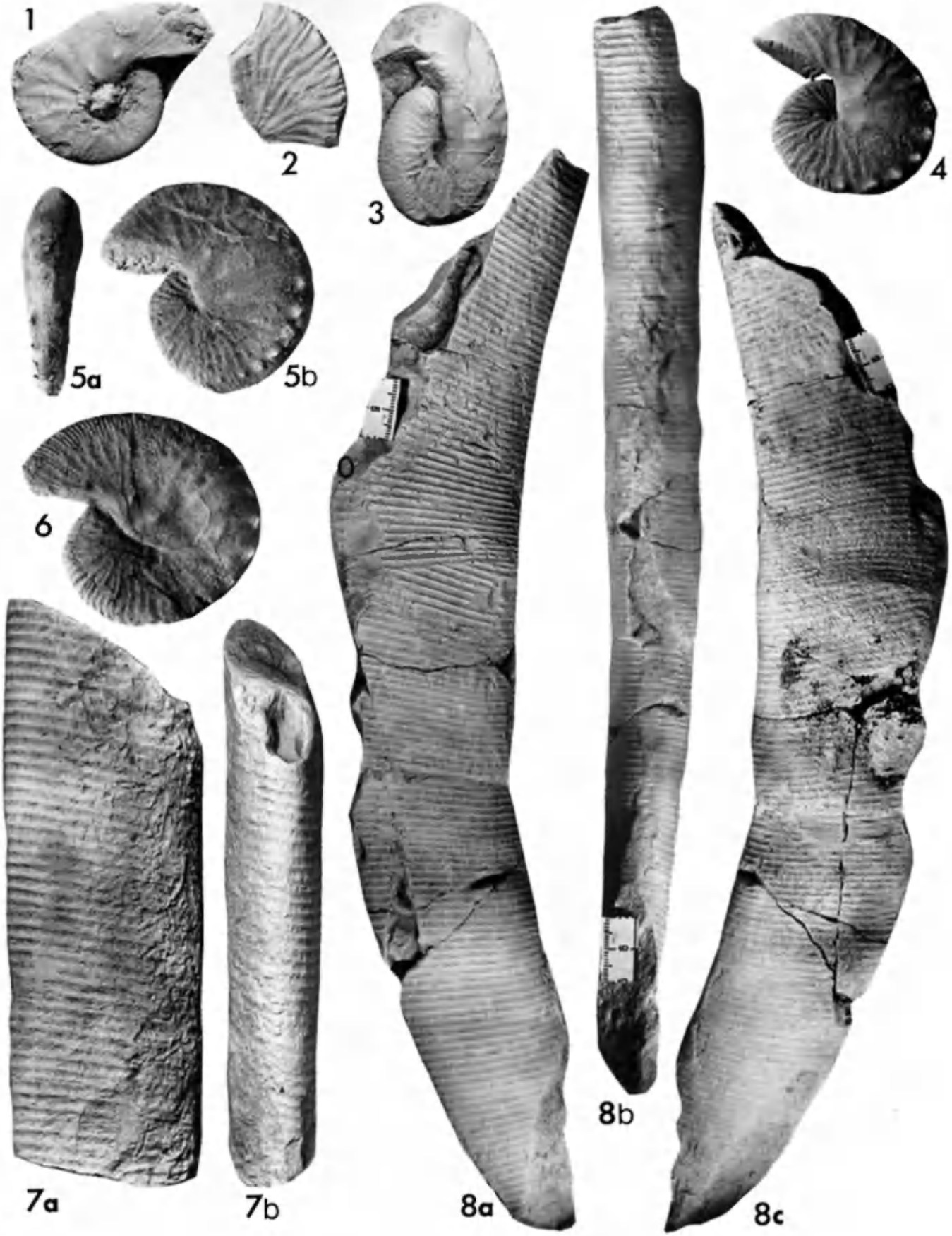

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