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Project: MID-CRETACEOUS EVENTS

Cenomanian ammonites from German Democratic Republic, Poland, and the Soviet Union

ABSTRACT: The Cenomanian ammonites from selected sections in German Democratic Republic (Subhercynian Basin and Saxony), Central Poland (Holy Cross Mts), and the Soviet Union (Podolia, Crimea, Caucasus, and Mangyshlak) are assigned to 98 species and subspecies of 27 genera. A great majority of the species show a wide geographic distribution which permits intercorrelation of the investigated sections, as well as a correlation of the regional stratigraphic zonation patterns used in German Democratic Republic, Poland, and the Soviet Union with that used in northwestern Europe (southern England and northern France). There is a considerable variation in composition of ammonite faunules and only a small one in facies among the investigated sections, which indicates that bathymetry was insignificant in controls of ammonite distribution at that time. The phylloceratids, tetragonitids, and gaudryceratids are almost entirely confined to Crimea and Caucasus. The two regions share also most of the species with northwestern Europe, with typical Boreal forms representative of the genera *Schloenbachia* and *Hyphoplites* included, which demonstrates a mixing of Boreal and Mediterranean ammonite faunas in that area. Boreal aspects of the Cenomanian ammonites faunas are recognizable also in Mangyshlak and Kopet-Dag in the Soviet Union and in Esfahan area in Iran. The southern boundary of the Boreal province must therefore have been south of the present-day position of Crimea Highland, Caucasus, and Kopet-Dag at the Cenomanian time. The Lower and Middle Cenomanian are very well documented with ammonites in the investigated sections as a rule, whereas the abundance of ammonites is considerably decreased in the Upper Cenomanian all over the investigated area (Upper Cenomanian ammonites have not been recorded in some sections) although there is no significant change in facies. A similar phenomenon can be observed in northwestern Europe, North Atlantic drillings, and also in the Pacific, which is suggestive of its pan-regional cause.

In paleontological description of the investigated ammonite taxa, good preservation state and large number of the specimens permitted recognition of micro- and macroconchs among representatives of the genera *Sciponoceras*, *Scaphites*, and *Puzosia*. A peculiar sexual dimorphism has been noted in *Sciponoceras baculoide* (Mantell), in which species the micro- and macroconchs differ from each other in the aperture type but not in the shell size or ornamentation.

INTRODUCTION

The present study is concerned with paleontological description of a large collection of Cenomanian ammonites from German Democratic Republic, Poland, and the Soviet Union. The investigated ammonite-bearing sections occur in the platform area, as well as in the Alpine geosyncline, over more than 3,200 km in distance (*cf.* Text-fig. 1). This is advantageous for recognition of the stratigraphic and biogeographic significance of the ammonites for the Cenomanian, and also permits an intercorrelation of various regional subdivisions of the stage (*cf.* Tables 1—2). In fact, regional analysis of the Cenomanian strata in the investigated areas was a long way in advance of paleontological description of the ammonite faunas and the resultant biostratigraphic and biogeographic implications. To close this gap in the knowledge of the Cenomanian is the aim of the present paper.

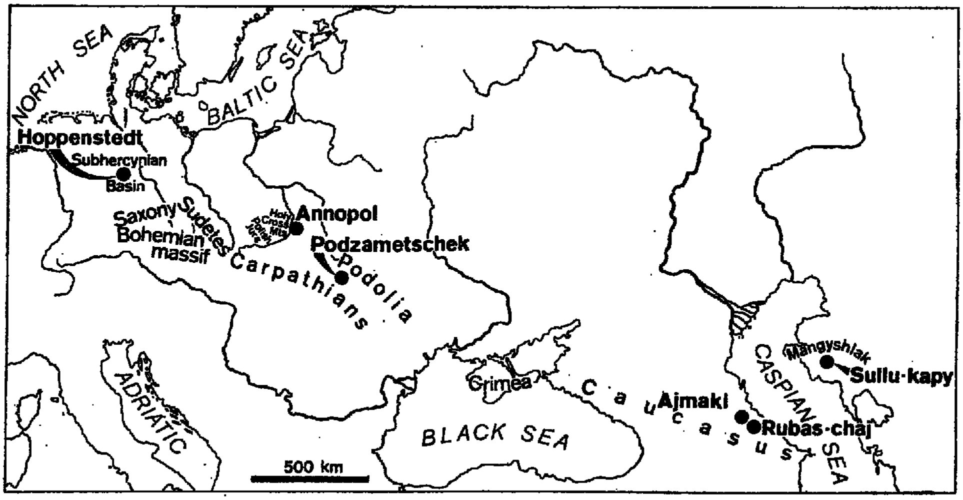

Fig. 1. Location of the sections (names indicated by heavy dots) discussed in the present paper

Regional situation of the investigated ammonite-bearing sections will therefore not be discussed in detail. The regional-geological setting of the sections was indeed presented for: the Subhercynian Basin and Saxony by Tröger (1969; *and* references therein); Central and southern Poland by Cieśliński (1959, 1976) and Marcinowski (1974); the Podolia by Kokoszyńska (1931), Pasternak (1968; *and* references therein), and Pasternak & Gavrilishin (1977); Crimea by Muratov (1949, 1960), Naidin & Janin (1965), Marcinowski & Naidin (1976), and Naidin & Alekseev (1980); North Caucasus by Moskvin (1959, 1962); and Mangyshlak by Trifonov & Burago (1960; *and* references therein).

Stratigraphic schema of the Cenomanian in southern England and northern France, and its correlation with regional subdivisions of this stage in the areas discussed in the present paper, and in Kopet-Dag in the Soviet Union

In the table presented are only the stratigraphically important taxa; some of the taxa are renamed as to their taxonomy, either at their generic or specific rank

SUBSTAGE	SOUTHERN ENGLAND & NORTHERN FRANCE /Juignet & Kennedy 1976/	SUBHERCYNIAN BASIN /Tröger 1978/		SOUTHERN POLAND /Marcinowski 1974/	
LOWER TURONIAN	Inoceramus labiatus, Mammites nodosoides	Inoceramus labiatus		Inoceramus labiatus	
UPPER CENOMANIAN	Sciponoceras gracille Zone	no fossils		Actinocamax primus, A. plenus, Sciponoceras baculoide, Schloenbachia cf. lymense, Calycoceras aff. lotzei /the last species from condensed sequence/	Calycoceras naviculare Zone
	Eucalycoceras pentagonum Zone				
MIDDLE CENOMANIAN	Acanthoceras jukesbrownei Zone	Schloenbachia varians /only in the lower part of the beds with Acanthoceras/, Acanthoceras rhotomagense	Beds with Acanthoceras	Sciponoceras baculoide, Scaphites obliquus, Puzosia planulata, Schloenbachia varians, S. cf. coupei, Acanthoceras sp.	Acanthoceras rhotomagense Zone
	Turrilites acutus Zone				
	Turrilites costatus Zone				
LOWER CENOMANIAN	Mantelliceras ex gr. dixoni Zone	Sciponoceras baculoide Turrilites scheuchzerianus, Hypoturrilites tuberculatus, Scaphites equalis, Hyphoplites falcatus, Schloenbachia varians, Mantelliceras mantelli, M. saxbii		Mariella lewesiensis, M. cenomanensis, Hyphoplites campichei campichei, H. falcatus aurora, Mantelliceras tuberculatum, M. aff. costatum, M. saxbii, M. ex gr. dixoni /all ammonites from condensed sequence/	Mantelliceras mantelli Zone
	Mantelliceras saxbii Zone				
	Neostlingoceras carcitanense Zone				
UPPER ALBIAN	Mortoniceras perinflatum, Stoliczkaia dispar	Aucellina gryphaeoides		Aucellina gryphaeoides, Inoceramus anglicus	

SUBSTAGE	SOUTH-WESTERN CRIMEA HIGHLAND /Naidin 1979, Naidin & Alekseev 1980/		NORTH CAUCASUS /Moskvin 1959, 1962/	
LOWER TURONIAN	Inoceramus labiatus		Inoceramus labiatus	
UPPER CENOMANIAN		no fossils	UPPER CENOMANIAN	Holaster subglobosus, Turrilites costatus, Scaphites equalis
MIDDLE CENOMANIAN		no ammonites		
	Beds with Turrilites costatus	Worthoceras sp., Turrilites costatus, Acanthoceras sp.	LOWER CENOMANIAN	Neohibolites ultimus, Schloenbachia varians, Mantelliceras mantelli
LOWER CENOMANIAN	Beds with Scaphites equalis	Mesogaudryceras ssp., Scaphites equalis obliquus, Mantelliceras mantelli		
	Beds with Neohibolites manjailenkoi	Inoceramus crippsi crippsi, Neohibolites menjailenkoi, Schloenbachia sp.		
UPPER ALBIAN	Aucellina gryphaeoides, Inoceramus anglicus, Mortoniceras perinflatum, Stoliczkaia notha		Aucellina gryphaeoides, Mariella bergeri	

SUBSTAGE	MANGYSHLAK /Schmidt, Trifonov & Jasukevich 1973/		
LOWER TURONIAN	Inoceramus labiatus		
UPPER & MIDDLE CENOMANIAN	UPPER CENOMANIAN	Acanthoceras rhotomagense Zone	Inoceramus cf. crippsi, Actinocamax plenus, Turrilites costatus, T. scheuchzerianus, Scaphites equalis, Schloenbachia varians, Acanthoceras rhotomagense, Euomphaloceras cunningtoni
LOWER CENOMANIAN	LOWER CENOMANIAN	Mantelliceras mantelli Zone	Schloenbachia varians, Mantelliceras mantelli
		Analogue of the Neohibolites ultimus Zone	Inoceramus crippsi, Actinocamax sp., Turrilites sp., Schloenbachia varians
UPPER ALBIAN	Arrhaphoceras studeri, Pleurohoplites renauxianus		

SUBSTAGE	WEST KOPET-DAG /Atabekyan 1960, 1961/			EAST KOPET-DAG /Dzhaborov, Manija & Kuryleva 1970, Manije 1974/		
LOWER TURONIAN	Inoceramuß labiatus			Inoceramus labiatus		
UPPER CENOMANIAN	UPPER CENOMANIAN	Acanthoceras rhotomagense Zone	Scaphites equalis, Acanthoceras rhotomagense, A. cf. jukesbrownei, A. aff. sussexiense /= A. aff. vectense/, Euomphaloceras cf. inerme /= Acanthoceras cf. evolutum/	UPPER CENOMANIAN	Protacanthoceras kopetdagensis Zone	Worthoceras vermiculum /= W. rochatianum/, Calycoceras bethyomphalum, C. crassum, C. cf. newboldi spinosum, C. cf. bruni, Protacanthoceras bunburianum, P. kopetdagensis
					Acanthoceras rhotomagense Zone	Scaphites obliquus, S. equalis, Acanthoceras rhotomagense, A. jukesbrownei, A. sussexiense /= A. vectense/, Euomphaloceras inerme /= A. evolutum/
MIDDLE CENOMANIAN		Euomphaloceras euomphalum Zone	Turrilites costatus, T. acutus, Schloenbachia varians, S. coupei, Euomphaloceras euomphalum, E. aff. inerme /=Acanthoceras aff. evolutum/		Euomphaloceras euomphalum Zone	Mesogaudryceras leptonema, Euomphaloceras euomphalum
						Turrilites costatus, T. acutus, Karamaites grossouvrei, Euomphaloceras inerme
LOWER CENOMANIAN	LOWER CENOMANIAN	Mantelliceras mantelli Zone	Mantelliceras mantelli, M. cantianum, M. ventnorense, Sharpeiceras schlueteri	LOWER CENOMANIAN	Mantelliceras mantelli Zone	Hyphoplites falcatus, Mantelliceras mantelli, M. cantianum
		Beds with Neohibolites ultimus	Neohibolites ultimus, Sciponoceras baculoide, Hyphoplites campichei, H. cf. costosus, Schloenbachia varians, S. coupei, Mantelliceras cf. saxbii		Schloenbachia subplana Zone	Neohibolites ultimus, Hamites duplicatus, Sciponoceras baculoide, Mariella lewesiensis, Hyphoplites campichei, Schloenbachia varians /= S. subplana/
UPPER ALBIAN	Aucellina gryphaeoides, Mariella bergeri, Stoliczkaia dispar, Saltericeras salteri					

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AMMONITE ZONATION OF THE CENOMANIAN STAGE

Hancock (1959) put forth a subdivision of the Cenomanian Stage into the Mantelliceras mantelli, Acanthoceras rhotomagense, and Calycoceras naviculare Zones equivalent to the Lower, Middle, and Upper Cenomanian, respectively. Kennedy's (1969, 1970, 1971) studies on the Cenomanian ammonites of southern England permitted recognition of "ammonite assemblages", meant more or less like subzones, in the Lower and Middle Cenomanian. Further research on the Cenomanian of southern England and northern France (Kennedy & Juignet 1975, Juignet & Kennedy 1976, Kennedy & Hancock 1976) allowed to establish three well defined substages of the Cenomanian including totally 8 ammonite coenozones.

This stratigraphic pattern is accepted in the present paper because it permits intercorrelation of distant sections in Boreal Europe and Mid--Asia (cf. Kennedy & al. 1979; *and* Table 1 in the present paper). Its universal nature is also corroborated by a recent attempt to correlate it with the stratigraphic subdivision of the Cenomanian applied in Japan (Kennedy & Hancock 1977).

The boundaries of the substages of the Cenomanian are defined below, and the ammonite zones are enumerated. The ammonite zonation is discussed in more detail later on in this paper, in the chapter dealing with stratigraphy of the investigated ammonite-bearing sections.

LOWER CENOMANIAN (Neostlingoceras carcitanense, Mantelliceras saxbii, Mantelliceras ex gr. dixoni Zones)

The lower boundary of the substage, and by implication of the whole stage, is marked by the first appearance of species representative of the genera *Hypoturrilites, Schloenbachia, Mantelliceras, Sharpeiceras* and *Acompsoceras*. The substage can be defined also by the total range of the genus *Mantelliceras*.

MIDDLE CENOMANIAN (Turrilites costatus, Turrilites acutus, Acanthoceras jukesbrownei Zones)

The lower boundary of the substage is marked by the appearance of the genus *Acanthoceras* associated with primitive representatives of the genus *Calycoceras* of the *gentoni* group, and by the disappearance of the genera *Mariella*, *Ostlingoceras*, and *Hyphoplites* persistent since the uppermost Albian. The boundary can also be characterized by replacement of the species *Schloenbachia varians* (J. Sowerby) and its varieties with the species *S. coupei* (Brongniart) and varieties (Kennedy & Juignet 1975, Kennedy & Hancock 1976). However, the latter characteristic appears to be restricted in validity to northwestern Europe because in some sections investigated by the present author (Hoppenstedt quarry in GDR, MGU Station in Crimea, Sullu-kapy in Mangyshlak) the species *S. varians* ranges up into the Middle Cenomanian, while *S. coupei* may appear already in the upper part of the Lower Cenomanian (MGU Station); furthermore, the two species co-occur in Kopet-Dag beginning with the base of the Cenomanian and up to and including the Turrilites acutus Zone (*cf.* Atabekyan 1961, Manija 1974). Large-sized, ornamented with coarse and widely spaced, alternately long and short ribs representatives of the genus *Acanthoceras*, recognized by Marcinowski (1979) for a dinstinct subgenus *Alternacanthoceras*, are characteristic of the upper part of the Middle Cenomanian (Acanthoceras jukesbrownei Zone).

UPPER CENOMANIAN (Eucalycoceras pentagonum, Sciponoceras gracile Zones)

The lower boundary of the substage is marked by the appearance of representatives of the genus *Calycoceras*, of the naviculare group associated with the genus *Thomelites* and the species *Schloenbachia lymense* Spath. The genera *Calycoceras, Eucalycoceras*, and *Thomelites* are dominant in the lower part of the substage, and the genera *Kanabiceras* and *Metoicoceras* in the upper part. The Cenomanian/Turonian boundary is defined by the appearance of *Mammites nodosoides* (Schlotheim) and *Inoceramus labiatus* (Schlotheim), the two species appearing simultaneously in the type area (Kennedy & Juignet 1973, Juignet & *al.* 1973). This boundary, as well as the Albian/Cenomanian boundary are very distinct and well documented paleontologically all over the investigated area (*cf.* Table 1).

Table 2. General distribution of Cenomanian ammonites in the investigated sections

Arrows denote the range of condensed sequence that yielded the investigated ammonites in particular sections

CENOMANIAN			SPECIES	SECTIONS							
LOWER	MIDDLE	UPPER		Hoppenstedt	Saxony	Annopol	Podzametschek	SW Crimea	Ajmaki	Rubas-chai	Sullu-kapy
+			Phylloceras seresitense seresitense					+			
+	+		Phylloceras cf. seresitense tanit					+	+		
+	+		Phylloceras sp.					+	+		
	+		Gaudryceras stefaninii					+			
	+		Gaudryceras sp.					+			
	+		Anagaudryceras cf. cassisianum					+			
	+		Mesogaudryceras leptonema					+			
	+		Mesogaudryceras rarecostatus					+			
+			Zelandites dozei dozei					+			
	+		Tetragonites sp.					+	+		
	+		Carinites sp.					+	+		
	+		Worthoceras rochatianum								+
	+		Worthoceras vermiculum								+
	+		Worthoceras sp.					+			+
+	+		Hamites duplicatus			+					+
	+		Hamites simplex						+		
+			Hamites sp.								+
?			Hemiptychoceras gaultinum subgaultinum					+			
+	+	+	Sciponoceras baculoide	+		+	?	+	+		+
+	+	+	Sciponoceras roto			+					+
	+		Sciponoceras sp.						+		
+	+		Anisoceras plicatile			+		+	+		+
			Anisoceras auberti			+					
+			Anisoceras aff. exoticum								+
			Idiohamites alternatus vectensis			+					
			?Idiohamites ellipticus ellipticus			+					
			Idiohamites aff. ellipticus radiatus			+					
	+		Idiohamites sp.					+			
+	+	+	Turrilites costatus	+		+	?	+		+	+
+	+	+	Turrilites scheuchzerianus	+		+	?				+
			Neostlingoceras carcitanense			+	?				
+			Hypoturrilites tenouklensis					+			
			Hypoturrilites gravesianus gravesianus			+					
+			Hypoturrilites gravesianus cf. gravesianus	+							
+			Hypoturrilites tuberculatus	+		+					
			Hypoturrilites mantelli			+					
+			Hypoturrilites? polytuberculatus	+							
			Hypoturrilites ssp.			+					
			Mariella cenomanensis			+					
			Mariella essenensis			+					
+			Mariella cf. lewesiensis					+			
+	+	+	Scaphites obliquus			+		+	+		
+	?		Scaphites equalis	+				?			
?	+		Scaphites bassese					+			+
	+		Scaphites evolutus								+
+	+	+	Scaphites ssp.	+		+	+	+	+		+
+	+		Puzosia planulata				?	+	+		
			Puzosia cf. planulata			+					
	+		Puzosia sp.	+							
+			Hyphoplites falcatus falcatus	+							+
+			Hyphoplites falcatus aurora								+
+			Hyphoplites falcatus interpolatus								+
+			Hyphoplites campichei campichei								+
+			Hyphoplites campichei densecostatus								+
+			Hyphoplites pseudofalcatus								+
+			Hyphoplites pylorus								+
+			Hyphoplites curvatus					+			+
+			Hyphoplites crassofalcatus crassofalcatus								+
+			Hyphoplites crassofalcatus horridus								+
+			Hyphoplites arausionensis								+
+			Hyphoplites sp. A								+
+			Hyphoplites sp.								+
+	+		Schloenbachia varians	+		+	+	+			+
+	+		Schloenbachia coupei			+		+	+		+
		+	Schloenbachia lymense			+					
+	+		Schloenbachia ssp.					+			
+	+		Karamaites grossouvrei								+
	+		Karamaites mediasiaticum								+
+			Mantelliceras mantelli	+				+	+	+	+
+			Mantelliceras aff. mantelli	+							
+			Mantelliceras saxbii	+		+					+
			Mantelliceras aff. ventnorense			+					
+			Mantelliceras picteti					+			
+			Mantelliceras tuberculatum			+			+		+
+			Mantelliceras lateretuberculatum					+			
			Mantelliceras tenue				+				
+			Mantelliceras costatum	+							
+			Mantelliceras biroi							+	
+			Mantelliceras ex gr. dixoni					+			
+			Mantelliceras cantianum	+							
+			Mantelliceras souaillonense	+							
+			Mantelliceras sp. /close to M. souaillonense/	+							
+			"Mantelliceras" aumalense								+
+			"Mantelliceras" suzannae								+
	+		Acompsoceras renevieri	+							
		+	Calycoceras naviculare		+						
		+	Calycoceras ex gr. naviculare		+						
		+	Calycoceras newboldi newboldi		+						
	+		Calycoceras spinosum nodosum	+							
			Calycoceras gentoni			+					
	+		Acanthoceras rhotomagense rhotomagense	+							
	+		Acanthoceras rhotomagense subflexuosum	+							
	+		Acanthoceras rhotomagense cf. subflexuosum						+		
	+		Acanthoceras rhotomagense sussexiense	+							
	+		Acanthoceras jukesbrownei	+							
	+		Acanthoceras cf. confusum					+			
	+		Acanthoceras ssp.	+							
	+		Pseudotissotia sp.					+			

DESCRIPTION OF THE AMMONITE-BEARING SECTIONS

SUBHERCYNIAN BASIN

LITHOLOGY AND AMMONITE DISTRIBUTION

The investigated section is exposed in the Hoppenstedt quarry in the northern limb of the Subhercynian Cretaceous Basin delimited in that area by the salt structure of Fallstein. The Cenomanian strata approximate 60 m in total thickness in that area. Cenomanian and Turonian rocks are well exposed in the Hoppenstedt quarry, the lowermost Cenomanian strata (*ca.* 10 m in thickness) being inaccessible (Tröger 1969, 1978). The Cenomanian and Turonian represent a carbonate facies including light-grey limestones alternating with marly limestones, marls, and sporadically marly clays. Ammonites are confined to the lower and middle part of the section (Text-fig. 2), which is also the case with other Cenomanian macrofossils (*cf.* Tröger 1969, 1978). No macrofossils have been recorded in the upper part of the Cenomanian, even though there is no change in lithofacies. The ammonite assemblage is dominated by the schloenbachiids (more than a half of the collection) associated with the mantelliceratids, acanthoceratids, and heteromorphs; other ammonites occur in minor amounts (*see* Text-fig. 2).

STRATIGRAPHY

The Lower Cenomanian is documented by the occurrence of the genera *Mantelliceras* and *Hyphoplites*. The presence of compressed representatives of the former genus, viz. *M. saxbii* (Sharpe), *M. costatum* (Mantell), *M.* aff. *mantelli* (J. Sowerby) (=finely ornamented forms transitional to *M. ventnorense* or close to *M. saxbii*), and *M. souaillonense* (Renz), associated with large amounts of *Schloenbachia varians* (J. Sowerby) and its varieties, and the absence of the genus *Mariella* indicate that the exposed part of the section is representative of the middle and upper parts of the Lower Cenomanian, *i.e.* the Mantelliceras saxbii and Mantelliceras ex gr. dixoni Zones (*cf.* Kennedy & Hancock 1976). The underlying, unexposed part of the section (8—10 m in thickness) may, at least in part, represent the Neostlingoceras carcitanense Zone. The upper boundary of the Lower Cenomanian is marked by the appearance of the genus *Acanthoceras* (see Text-fig. 2). There is no sedimentary discontinuity or change in lithofacies at that boundary.

The Middle Cenomanian (=Beds with *Acanthoceras* of Tröger 1969) yielded *Acanthoceras rhotomagense* (Brongniart) and its subspecies, *A. jukesbrownei* Spath, and *Calycoceras spinosum nodosum* (Thomel) among others, which may indicate the occurrence of all the three constituent ammonite zones of the substage (Turrilites costatus, Turri-

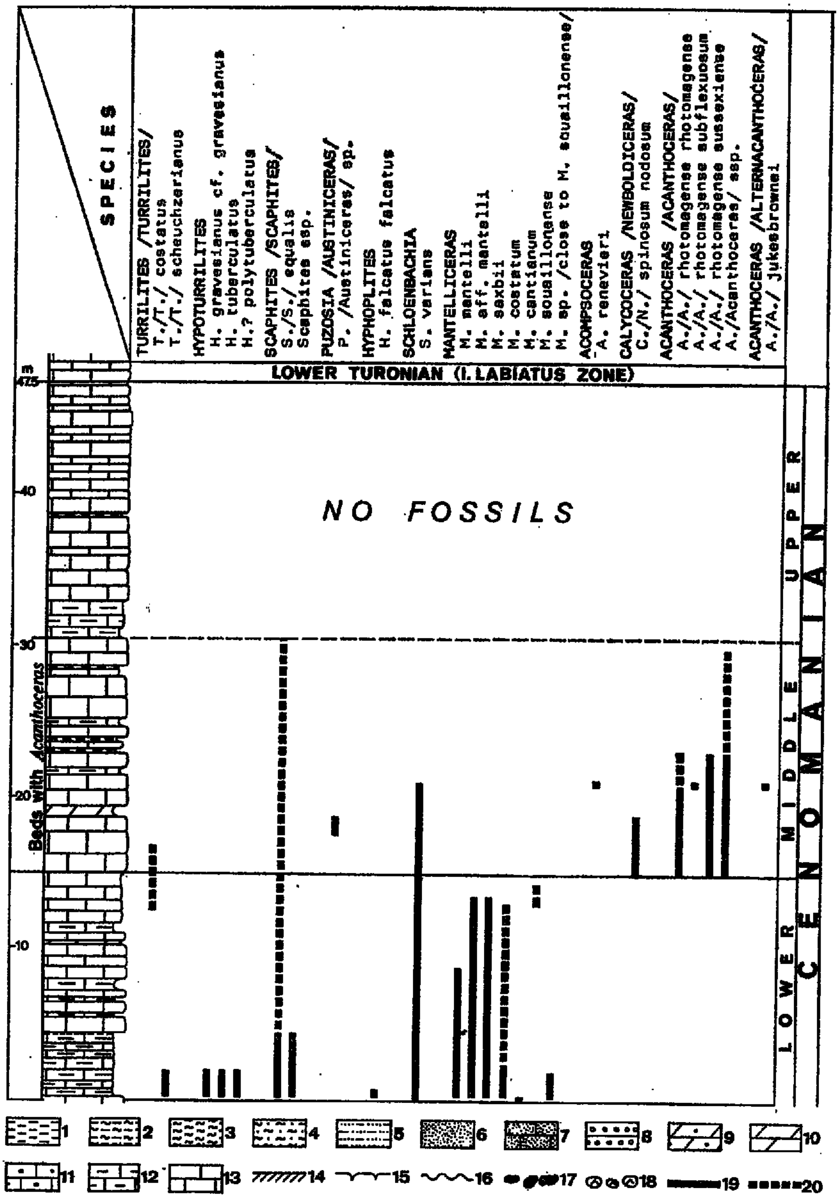


Fig. 2. Distribution of Cenomanian ammonites in the Hoppenstedt Quarry section, northern limb of the Subhercynian Basin, GDR (*after*: Tröger 1969, and his unpublished data)

Lithology and other symbols (for all the profiles presented in Text-figs 3—4, 6, 9—10, and 12):

1 clays or claystones, *2* silty clays, *3* silts or siltstones, *4* sandy siltstones, *5* clayey sands, *6* sands, *7* sandstones, *8* gravels, *9* sandy marls, *10* marls, *11* sandy limestones, *12* marly limestones, *13* limestones, *14* omission surfaces, *15* hardgrounds, *16* subaqueous erosion surfaces, *17* phosphatic nodules, *18* ferro-siliceous nodules with a phosphatic content, *19* recognized range of the species (when represented by a single specimen, this is an interval the specimen comes from), *20* supposed range of the species lites acutus, and Acanthoceras jukesbrownei Zones), even though the upper part of the substage cannot be unequivocally traced (*see* below). The species *Schloenbachia varians* (J. Sowerby), in particular its *subvarians* morphotype, ranges into the Middle Cenomanian in the investigated section, while it is replaced with *S. coupei* (Brongniart) in the Middle Cenomanian of southern England and northern France (*cf.* Kennedy & Juignet 1975, Kennedy & Hancock 1976). In turn, *Acanthoceras jukesbrownei* Spath, representative of large-sized, ornamented with coarse, widely spaced, alternately long and short ribs acanthoceratids separated by Marcinowski (1979) in the subgenus *Alternacanthoceras*, appears in the Hoppenstedt quarry above the lower boundary of the Middle Cenomanian, as it is the case also in England (*cf.* Kennedy & Hancock 1976).

The Middle/Upper Cenomanian boundary can be traced only arbitrarily in the Hoppenstedt section, at the complete disappearance of macrofossils. The Cenomanian/Turonian boundary is, in its turn, very precisely marked by the appearance of *Inoceramus labiatus* (Schlotheim) and its subspecies (Tröger 1969, 1978).

SAXONY

REMARKS ON LITHOLOGY, STRATIGRAPHY, AND AMMONITE DISTRIBUTION

The Cretaceous outcrops in Saxony occur between the Lusatian block and the Fichtel-Erzgebirge anticlinorium. They have been for long referred to under the name Elbtalkreide (Elbe Cretaceous). The traditional lithostratigraphic units of the Cenomanian of Saxony (*see* Tröger 1969 and references therein) are given below as a framework for presentation of stratigraphic distribution of the investigated ammonites.

NIEDERSCHÖNA BEDS. Fluvial-limnic, conglomeratic-sandy-clayey, plant-bearing deposits ranging from ?Albian to Cenomanian in age.

UNTERQUADER. Marine, fine- to medium-grained sandstones, replaced with conglomerates and coarse-grained sandstones in proximity of source areas, often cross-bedded. The Unterquader overlies disconcordantly and transgressively the Niederschöna Beds or Paleozoic rocks. In a great majority of the Elbtalkreide area (Dresden, Freiberg, Pirna), the Unterquader represents the Upper Cenomanian. However, it includes also a part of the Middle Cenomanian northwestwards (where the transgression came from), as indicated by the occurrence of a specimen of *Schloenbachia varians* (J. Sowerby) in the Unterquader of Meissen region (Tröger 1969, p. 3). The Unterquader of Dresden and Freiberg area yielded the specimens of *Calycoceras naviculare* (Mantell), *C.* ex gr. *naviculare* (Mantell), and *Calycoceras newboldi newboldi* (Kossmat) described in the present paper. The occurrence of *Calycoceras* ex gr. *naviculare* (Mantell) along with *C. newboldi newboldi* (Kossmat) in the Unterquader at Niederschöna by Freiberg makes the evidence for assignment of those strata to the lower part of the Upper Cenomanian, *i.e.* the Eucalycoceras pentagonum Zone. This is not the case with sporadic occurrences of *C. naviculare* (Mantell) in other outcrops of the Unterquader because the latter species, even though characteristic of the Eucalycoceras pentagonum Zone, ranges also into the uppermost Cenomanian, *i.e.* the Sciponoceras gracile Zone (*cf.* Kennedy & Juignet 1975, Juignet & Kennedy 1976, Kennedy & Hancock 1976). It is noteworthy that a single specimen of *Actinocamax* ?ex gr. *primus/plenus* also was recorded in the Unterquader (*see* Tröger 1976).

PLENUS ZONE. Siltstones, sandstones, sandy marls, and marly limestones replaced with conglomerates and breccias of the klippen facies in proximity of the source areas. The Plenus Zone overlies transgressively the Unterquader or older rocks. As evidenced by a few occurrences of *Actinocamax plenus* (Blainville) with no records of either *Calycoceras naviculare* (Mantell), or *Inoceramus labiatus* (Schlotheim) (*see* Tröger 1969), the Plenus Zone is representative, at least in part, of the Sciponoceras gracile Zone. It is noteworthy that *Actinocamax plenus* (Blainville) occurs below the first appearance of *Inoceramus labiatus* (Schlotheim) also in GFR (*cf.* Schmid 1965) and Poland (*cf.* Marcinowski 1972).

HOLY CROSS MTS

LITHOLOGY AND AMMONITE DISTRIBUTION

The Middle Cretaceous outcrops of the northeastern Mesozoic margin of the Holy Cross Mts, Central Poland, form an anticline in Annopol region. The strata are less thick in that area than their time-equivalents from the northeastern Mesozoic margin of the Holy Cross Mts, which is caused by a stratigraphic condensation of the Middle Albian to Lower Turonian deposits (*cf.* Samsonowicz 1925, 1934; Pożaryski 1947, 1948; Cieśliński 1959, 1976). The 40 cm thick layer of the Middle to Upper Albian phosphorites (Hoplites dentatus to Stoliczkaia dispar Zones incl.) is overlain with sedimentary continuity by the Cenomanian sandy--glauconitic marls with phosphatic concretions. The Cenomanian strata are thin (Text-fig. 3) and the fauna, most commonly preserved in form of phosphatic moulds, is representative of virtually all the invertebrate phyla as well as of some vertebrates (teeth of diverse fish and marine reptiles; *cf.* Samsonowicz 1925, Radwański 1968). The proportion of detrital quartz, glauconite, and phosphatic concretions gradually de-

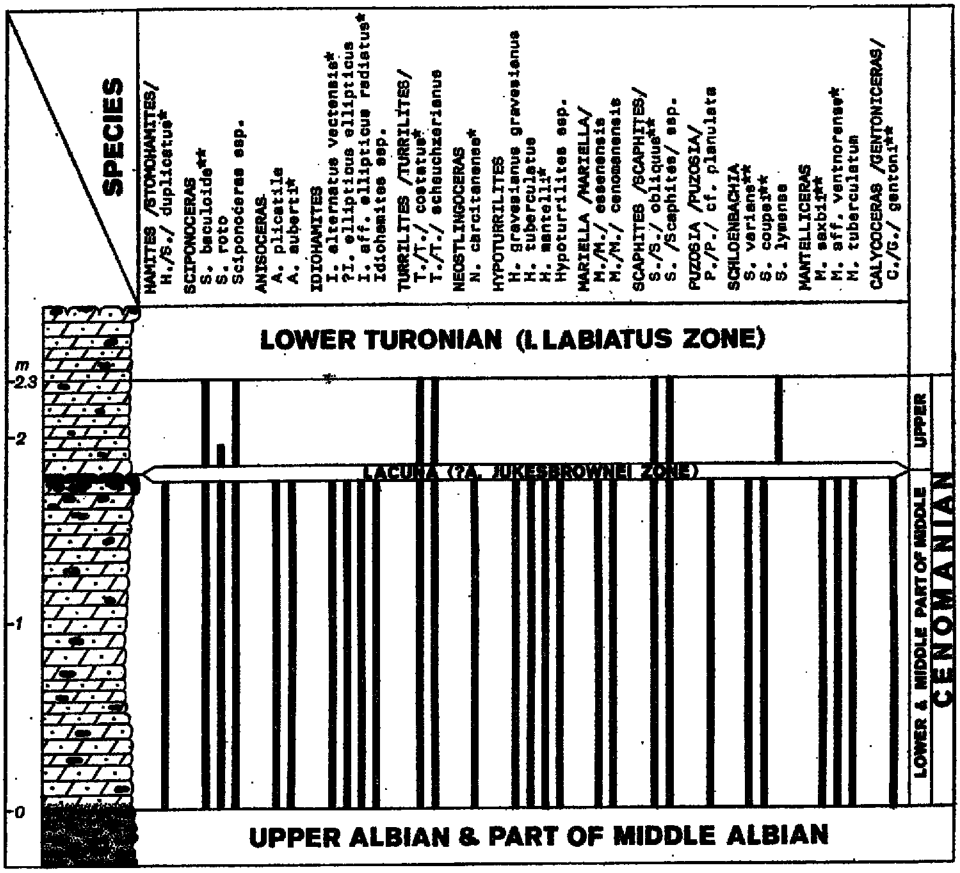


Fig. 3. Distribution of Cenomanian ammonites in the Annopol region, NE Mesozoic margin of the Holy Cross Mts, Central Poland (partly based on the data presented by Cieśliński, 1959)

Asterisked are the species formerly unknown from Annopol, double astersiked are those reported by Cieśliński (1959) but revised by the present author; other explanations as for Text-fig. 2

creases upwards. There is no sedimentary discontinuity or considerably change in lithofacies at the Cenomanian/Turonian boundary. In the upper part of the Cenomanian, 170—180 cm above the Albian/Cenomanian boundary, phosphatized sandy marls form concretions of nodular habitus. The phosphatized concretions commonly are all around encrusted with serpulids and ?corals, and embedded within weakly lithified sandy marls devoid of phosphorites. This is a hardground developed due to a phosphatization and early lithification of the sediment under conditions of inhibited sedimentation, succeeded by erosion and redeposition. Phosphatized fossils also are commonly encrusted with serpulids at the hardground (this is especially the case with moulds or tests of *Holaster* and *Micraster*). Ammonites abound in the Cenomanian strata up to and including the hardground where they attain the maximum frequency; this is the case also with other macrofossils. The abundance of ammonites and other macrofossils is considerably decreased above the hardground, which is reflected also in very low taxonomic diversity (*cf.* Text-fig. 3).

STRATIGRAPHY

The ammonite faunule is dominated by the schloenbachiids (60—70% of the assemblage) and heteromorphs, while other groups occur in minor amounts. There is no sedimentary discontinuity at the Albian/Cenomanian boundary. Furthermore, the ammonite species *Neostlingoceras carcitanense* (Matheron), *Mantelliceras tuberculatum* (Mantell), and *M. saxbii* (Sharpe) have been recorded in the section, which indicates that the lowermost Cenomanian strata do occur. This greatly undermines Cieśliński's (1976, p. 262) assertion that a stratigraphic gap occurs in Annopol area at the Albian/Cenomanian boundary, including the Lower and a part of the Middle Cenomanian. In turn, the co-occurrence of ammonites characteristic of various ammonite zones, recorded in the Cenomanian strata up to and including the hardground, is indicative of a stratigraphic condensation and faunal mixing. The association of *Mariella cenomanensis* (Schlüter), *M. essenensis* (Geinitz), *Turrilites costatus* Lamarck (frequent in the hardground), *Neostlingoceras carcitanense* (Matheron), *Mantelliceras tuberculatum* (Mantell). *M. saxbii* (Sharpe), *Schloenbachia varians* (J. Sowerby), *S. coupei* (Brongniart), and *Calycoceras gentoni* (Brongniart) among others, permits an estimation of the condensed sequence for the Lower to middle Middle Cenomanian (*cf.* Text-fig. 3). The absence of large-sized, ornamented with coarse and widely spaced, alternately long and short ribs representatives of the genus *Acanthoceras,* as well as the occurrence of a typical Upper Cenomanian species, *Schloenbachia lymense* Spath, above the hardground indicate that a stratigraphic gap probably comprising the Acanthoceras jukesbrownei Zone is associated with the hardground (*cf.* Text-fig. 3). The Upper Cenomanian is documented by *Schloenbachia lymense* Spath and *Actinocamax plenus* (Blainville) recorded above the hardground. The occurrence of *S. lymense* Spath, confined generally to the Eucalycoceras pentagonum Zone (*cf.* Juignet & Kennedy 1976, Kennedy & Hancock 1976) and a sedimentary continuity to the Lower Turonian documented by the appearance of *Inoceramus labiatus* (Schlotheim) demonstrate that the entire Upper Cenomanian (with the Sciponoceras gracile Zone included) occurs in Annopol area, even though its deposits do not exceed 50 cm in thickness (*cf.* Text-fig. 3).

PODOLIA

LITHOLOGY AND AMMONITE DISTRIBUTION

The investigated Podzametschek section is located at the left border of Strypa river where the Oldred Sandstone ic overlain by Cenomanian to Turonian strata covered, in turn, by green sands of Tertiary age (Text-fig. 4). The lithostratigraphic units and their paleontologic contents are given after Kokoszyńska (1931, pp. 650—651).

Band 1. Green, coarse-grained quartz sands with large amounts of glauconite and some pebbles, filled up with terebratulid shells.

Band 2. Yellow-grey, thick-bedded, hard marls with considerable amounts of glauconite and phosphatic concretions, sandy at the base, with *Aucellina gryphaeoides* (Sowerby).

Band 3. White grey, friable, platy marls with glauconite and phosphatic concretions, the latter being somewhat less abundant than in the Band 2.

The Bands 2—3 contain abundant fossils, most commonly preserved in form of phosphatic moulds, representative of the brachiopods, gastropods, pelecypods, cephalopods (ammonites, nautiloids, and belemnites), and echinoids. Kokoszyńska (1931) recorded the following stratigraphically important taxa: *Neostlingoceras carcitanense* (Matheron) [="*Turrilites Morrissi* Sharp." of Kokoszyńska (1931)], *Turrilites costatus* Lamarck, *T. scheuchzerianus* Bosc, *Mantelliceras mantelli* (J. Sowerby), *Calycoceras gentoni* (Brongniart), *Schloenbachia varianr* (J. Sowerby), *Neohibolites ultimus* (d'Orbigny), and *Actinocamax plenus* (Blainville). By the courtesy of Professor Makowski, the author has at his disposal also *Schloenbachia varians* (J. Sowerby) with its morphotypes *subvarians, subtuberculata*, and *ventriosa*, and *Mantelliceras tenue* Spath (Pl. 11, Fig. 1 in the present paper) derived from the same part of the section (most probably the Band 2).

Band 4. White limestones wiht scarce phosphatis concretions.

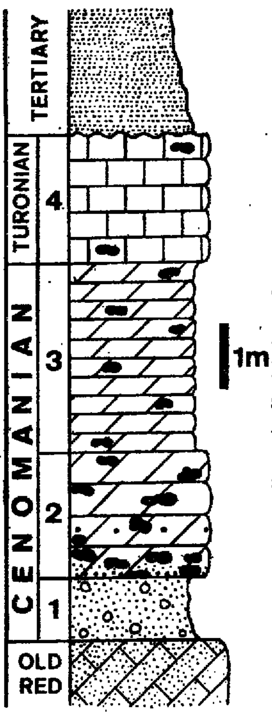


Fig. 4
Cenomanian and Turonian deposits exposed at Podzametschek near Butschatsch in the Podolia, Soviet Union (*after:* Kokoszyńska, 1931)

STRATIGRAPHY

The sandy deposits of the Band *1* do not yield any stratigraphically important fossils but nonetheless, their position in the section is indicative of their doubtless attribution to the Cenomanian (this is the case all over the Podolia). The ammonite and belemnite fauna of the Bands *2—3* clearly indicates that this part of the section is equivalent to the whole Cenomanian, being stratigraphically condensed and containing mixed faunas typical of various ammonite zones (*cf.* Pasternak & Gavrilishin 1977, p. 77). A similar situation occurs in the Lower

Turonian of the Central Podolia (Band *4*) where Cenomanian fossils co-occur (*cf.* Pasternak & Gavrilishin 1977) with an undoubtedly Lower Turonian species, *Collignoniceras woolgari* (Mantell).

SOUTHWESTERN CRIMEA HIGHLAND

Cenomanian rocks are widely distributed and well exposed in the Southwestern Crimea Highland (Text-figs 5a and 7). They overlie various units of the Upper Albian (Beds with *Mortoniceras*, or Beds with *Stoliczkaia* of Marcinowski & Naidin 1976), most commonly with a submarine erosional surface at the Albian/Cenomanian boundary (Marcinowski & Naidin 1976, Naidin & Alekseev 1980). The Cenomanian is more or less constant in lithology over the investigated area which permits compilation of a composite geological section and precise location of the ammonites in the lithostratigraphic Bands (*see* Text-fig. 6= =Text-fig. 3 *of* Naidin & Alekseev 1980). The lithostratigraphic and biostratigraphic subdivisions of the Cenomanian of the Southwestern Crimea Highland were discussed repeatedly (Naidin & *al.* 1975, Naidin 1979, Naidin & Alekseev 1980) and hence, only some general remarks are given below.

GENERAL REMARKS ON LITHOLOGY AND AMMONITE DISTRIBUTION

Virtually all the Cenomanian of the Southwestern Crimea Highland is represented by various marls, with limestone intercalations in the middle part of the section (Bands *IV-1* and *IV-2*) being reliable correlation horizons (Text-fig. 5*b*). Detritic quartz and glauconite are confined to the lowermost part of the section (Band *I*) and rapidly disappear from the overlying rocks. Local discontinuities of omission surface nature abound in the lower part of the section, while a submarine erosional surface recognizable all over the Southwestern Crimea Highland occurs at the boundary between the Bands *IV-1* and *IV-2*, that is at the Lower/Middle Cenomanian boundary (*cf.* Text-fig. 5*b*). The marls overlying directly the latter surface (base of the Band *IV-2*) include pebbles derived from the underlying limestones (Beds *1—2* of the Band *IV-1*) and sporadically also from the Taurica Formation (Upper Triassic--Liassic). Ammonites, as well as the associated macrofauna are confined to the lower and middle part of the section (up to and including the base of the Band *V*); however, pelecypods range sporadically up to the top of the Band *V* (see Naidin & Alekseev 1980). The ammonites are more or less uniformly distributed all over the fossiliferous part of the section, except for the limestone of the Bed *5* of the Band *IV-2* replete with *Sciponoceras* shell-casts (*see* Text-figs 5b and 8). The ammonites are poorly preserved in the marls, most commonly as deformed imprints or moulds, which makes them generally unidentifiable. Those found in

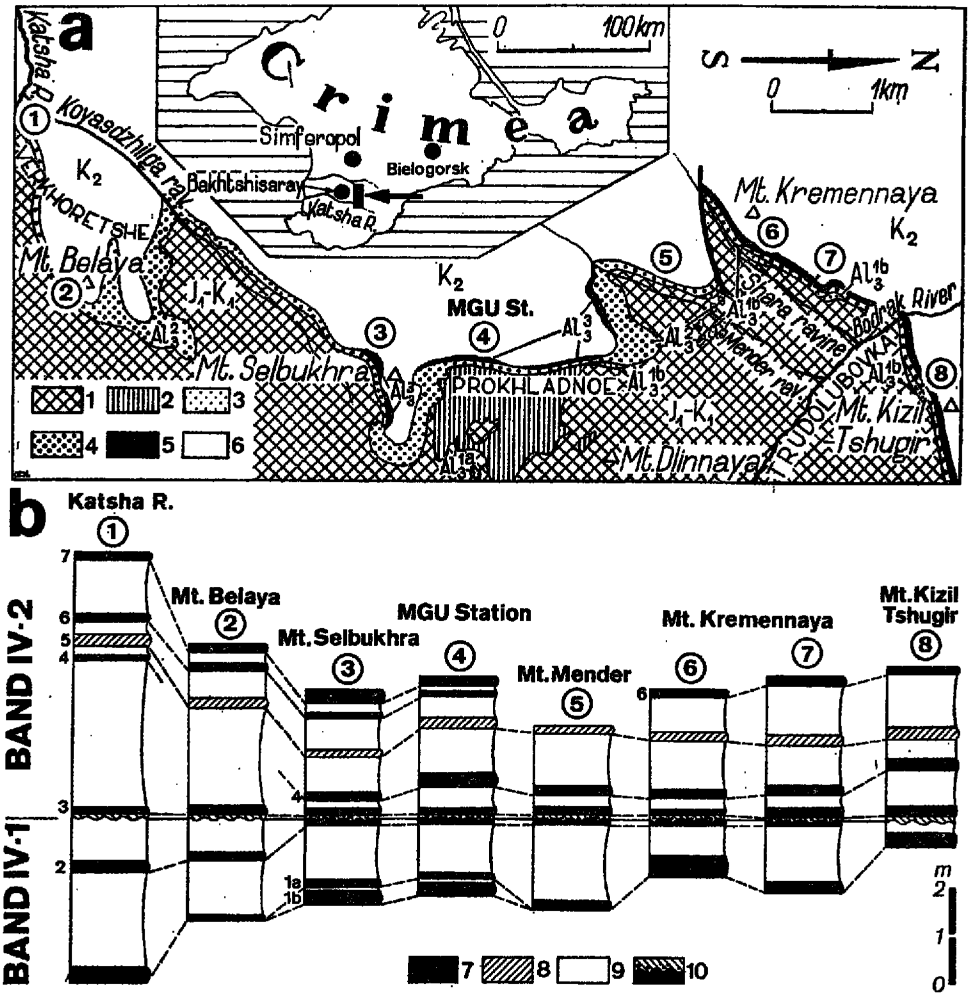


Fig. 5. Cenomanian deposits of the south-western Crimea Highland, Soviet Union (for general location see Text-fig. 1)

a — Geological sketchmap of the area between rivers Katsha and Bodrak (arrowed in the inset); the map and stratigraphic subdivision after Marcinowski & Naidin (1976, Text-fig. 1, and Tables 1 and 4); circled numbers denote the profiles discussed in the text, and displaying the Lower/Cenomanian boundary (*see* Text-fig. 5*b*)

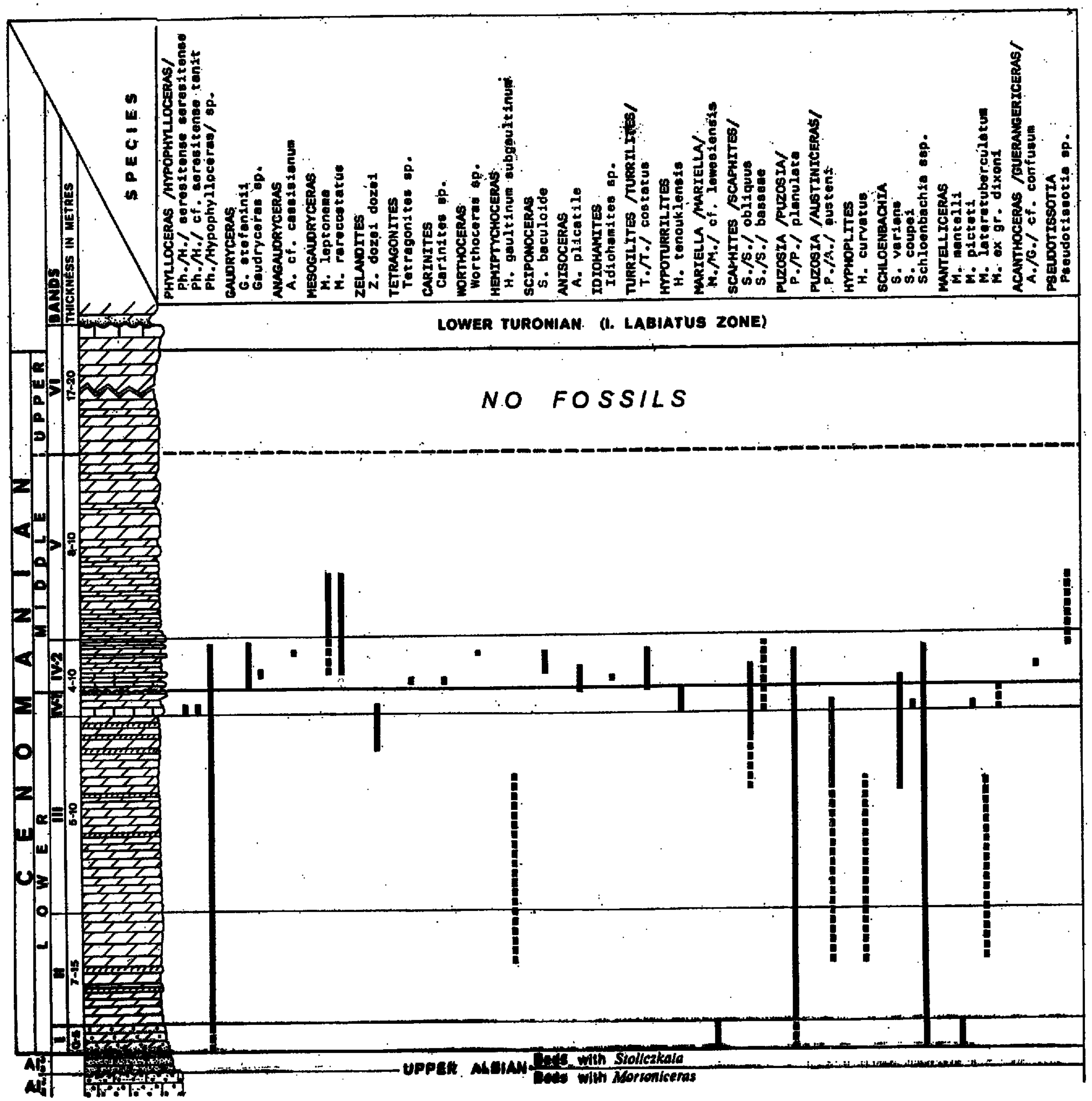
1 pre-Albian substrate (Lower and Middle Jurassic through Neocomian and Aptian, signed as J_1—K_1);

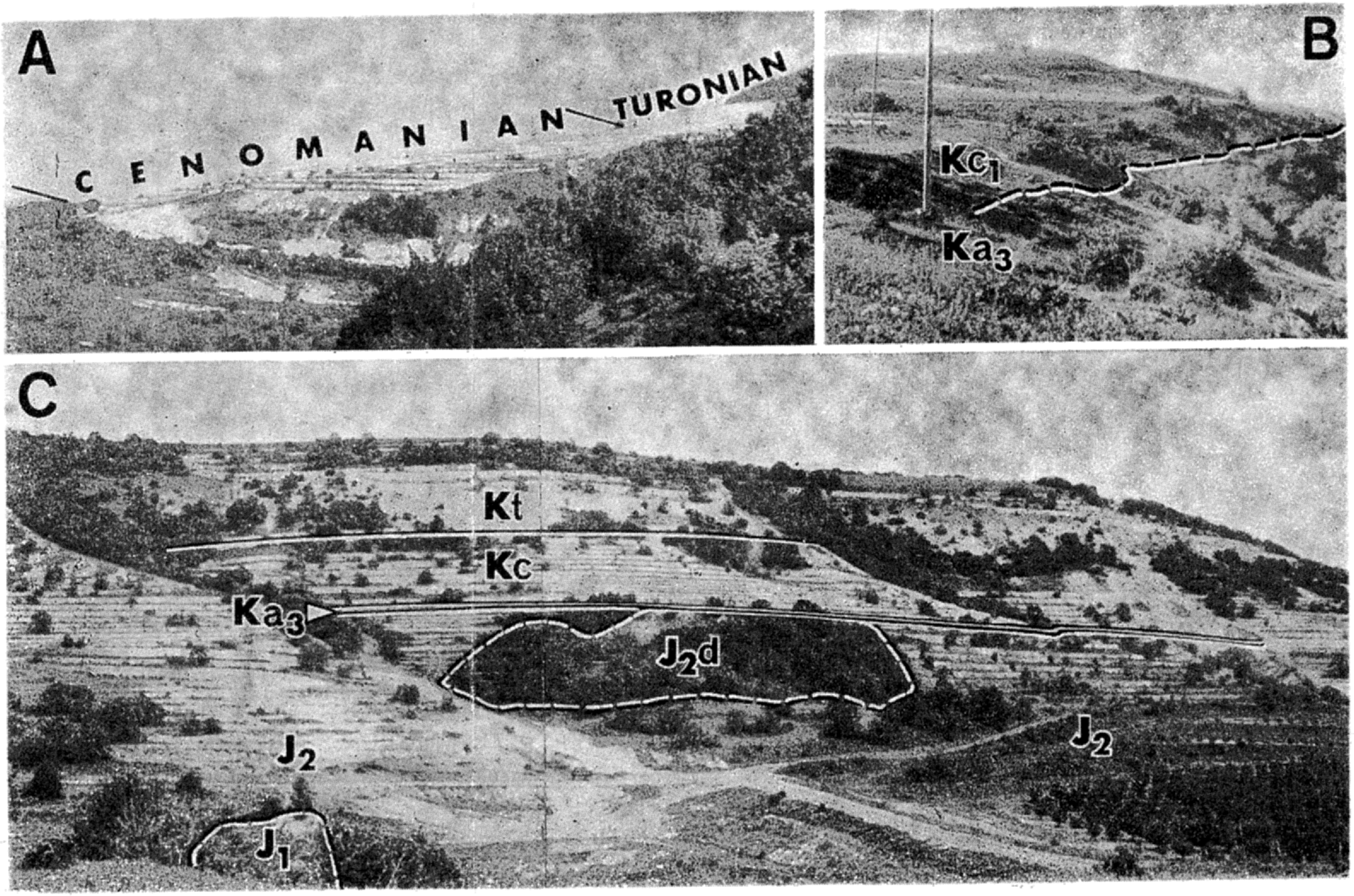
Upper Albian: *2* beds with *Hysteroceras* (Al_3^{1a}), *3* beds with *Scaphites* (Al_3^{1b}), *4* beds with *Mortoniceras* (Al_3^{2}), *5* beds with *Stoliczkaia* (Al_3^{3})
6 Upper Cretaceous (K_2)

b — Detailed profiles straddling the Lower/Middle Cenomanian boundary in SW Crimea Highland (*after:* Naidin & Alekseev, 1980); names of the profiles, numbers of bands (*IV-1, IV-2*) and beds (*1—7*) are the same as in Text-fig. 6 and description of the ammonite taxa

7 greyish limestones, *8* greyish limestones with gregarious *Sciponoceras* (cf. Text-fig. 8), *9* greyish marls, *10* greenish-grey, glauconitic marls with limestone pebbles

Distribution of Cenomanian ammonites in the south-western Crimea Highland (general profile after: Naidin & Alekseev, 1980); explanations as for Text-fig. 2





Exposures of the Upper Albian, Cenomanian and Turonian deposits in SW Crimea Highland, Soviet Union

A — Northern slope of Mt. Selbukhra at MGU Station

B — Mt. Tsheger at Prokhladnoe, just beneath MGU Station: Ka_3 calcareous glauconitic sandstone with tuffaceous material (Upper Albian, beds with *Stoliczkaia* of Marcinowski & Naidin, 1976), Kc_1 sandy marls with abundant belemnite guards (Lower Cenomanian, Band *I* in Text-fig. 6; *cf. also* Marcinowski & Naidin, 1976, Text-fig. 6*D*)

C — South-eastern slope of Mt. Kremennaya: J_1 Liassic olistolite embedded in Middle Jurassic clastics, J_2 Middle Jurassic clastics, J_2d diabases, Ka_3 calcareous glauconitic sandstones with tuffaceous material (Upper Albian, beds with *Stoliczkaia*), *Kc* Cenomanian marls with few limestone intercalations in the middle part, *Kt* Turonian chalky marls and limestones the limestones (Beds *1—7* of the Bands *IV-1* and *IV-2*) are better preserved and identifiable to the specific level; hence, most ammonite taxa recorded in that area have been reported from the latter stratigraphic interval. This may suggest that the ammonite frequency is much increased in that interval, which is not the case (*cf.* Text-fig. 6). The ammonite assemblage is dominated by the schloenbachiids, puzosiids, mantelliceratids, and heteromorphs (*Sciponoceras, Turrilites, Scaphites*), all of them represented most commonly by species reported also from northwestern and Central Europe. When compared to the latter region, the Southwestern Crimea Highland ammonites include, however, more representatives of the families Phylloceratidae, Gaudryceratidae, and Tetragonitidae (*cf.* Text-fig. 6), and of the genus *Puzosia.*

REMARKS ON STRATIGRAPHY

The occurrence of ammonite species widely distributed in the northwestern Europe also in the Southwestern Crimea Highland (*cf.* Text--fig. 6) permits subdivision of the Cenomanian strata of the latter area into three substages and their correlation with the former region (*cf.* Naidin 1979, Naidin & Alekseev 1980; *and* Table 1 in the present paper). The Middle/Upper Cenomanian boundary is the only one traced arbitrarily, at the disappearance of macrofossil remains. The Cenomanian//Turonian boundary is marked by the first appearance of *Inoceramus labiatus* (Schlotheim). The recognition of the Beds with *Neohibolites menjailenkoi*, Beds with *Scaphites equalis*, and Beds with *Turrilites costatus* in the Lower and Middle Cenomanian and their correlation with the ammonite zones established in southern England (*see* Naidin 1979, Naidin & Alekseev 1980) seem precarious because these units have only one well defined boundary each (either the lower boundary, or the upper one, but never both); actually, they are to be considered as local stratigraphic horizons.

The scarcity of ammonites in the Cenomanian of the Southwestern Crimea Highland makes impossible tracing precisely the boundaries between most ammonite zones (except for the Mantelliceras ex gr. dixoni/Turrilites costatus Zone boundary = Lower/Middle Cenomanian boundary) but nevertheless, the ammonite succession often resembles closely that one recorded in southern England. For instance, *Turrilites costatus* Lamarck first appears just below the Lower/Middle Cenomanian boundary and abounds in the lower Middle Cenomanian, just as it is the case in southern England. The species *Hypoturrilites tenouklensis* (Pervinquière) recorded at the top of the Lower Cenomanian in southern England (Kennedy 1971, p. 25) occurs in the Southwestern Crimea Highland in exactly the same stratigraphic position. There is a resemblance also in the stratigraphic distribution of the mantelliceratids. At the base of the Cenomanian strongly nodose species occur in the section at the southern slope of Mt. Selbukhra, e.g. *Mantelliceras mantelli* (J. Sowerby); whereas species with ribbing prevalent over the tubercles, such as *Mantelliceras picteti* Hyatt or *M.* ex gr. *dixoni* Spath, first appear close to the Lower/Middle Cenomanian boundary. On the other hand, *Schloenbachia varians* (J. Sowerby) ranges up to the lower Middle Cenomanian (as it is the case also in the Hoppenstedt quarry, *cf.* Text-fig. 2), while *S. coupei* (Brongniart) first appears below the Lower/Middle Cenomanian boundary; the two species show thus wider stratigraphic ranges in the Southwestern Crimea Highland than in southern England (*cf.* Kennedy & Juignet 1975, Kennedy & Hancock 1976). The genus *Acanthoceras*, typical of the Middle Cenomanian of northwestern Europe, very rarely occurs in the area under discussion. Thus far, its

Fig. 8. Limestone with gregarious *Sciponoceras baculoide* (Mantell); Middle Cenomanian, Band IV-2 Bed 5, SW Crimea Highland; nat. size

only record is that of *Acanthoceras* cf. *confusum* (Guéranger) [=*Acanthoceras* sp. of Naidin & Alekseev 1980]. It is noteworthy that *Pseudotissotia* sp. [=*Acompsoceras* sp. of Naidin & Alekseev 1980] has been recorded in the Middle Cenomanian of the Southwestern Crimea Highland (*cf.* Pl. 2, Fig. 15 in the present paper), which genus was unknown from below the Upper Cenomanian (*cf.* Kennedy & Bayliss 1977).

DAGESTAN CAUCASUS

REMARKS ON LITHOLOGY, STRATIGRAPHY, AND AMMONITE DISTRIBUTION

Cenomanian rocks overlie continuously the Upper Albian in the Dagestan Caucasus which is a part of North Caucasus. In the investigated sections at Ajmaki and Rubas-chaj (*cf.* Text-figs 9—10) the Cenomanian is represented by grey-green marls interbedded with light--grey to white limestones and marly limestones. The lower boundary of the Cenomanian is marked by the first appearance of the genera *Schloenbachia* nad *Mantelliceras*, and the upper boundary by *Inoceramus labiatus* (Schlotheim). It is to be noted that the lower part of the Inoceramus labiatus Zone is lacking from several sections in the Dagestan Caucasus owing to a regional stratigraphic gap (Moskvin 1959).

Moskvin (1959, 1962) subdivided the North Caucasian Cenomanian into the lower and upper substages, and noted that *Mantelliceras mantelli* (J. Sowerby) ranges up into the Upper Cenomanian in some

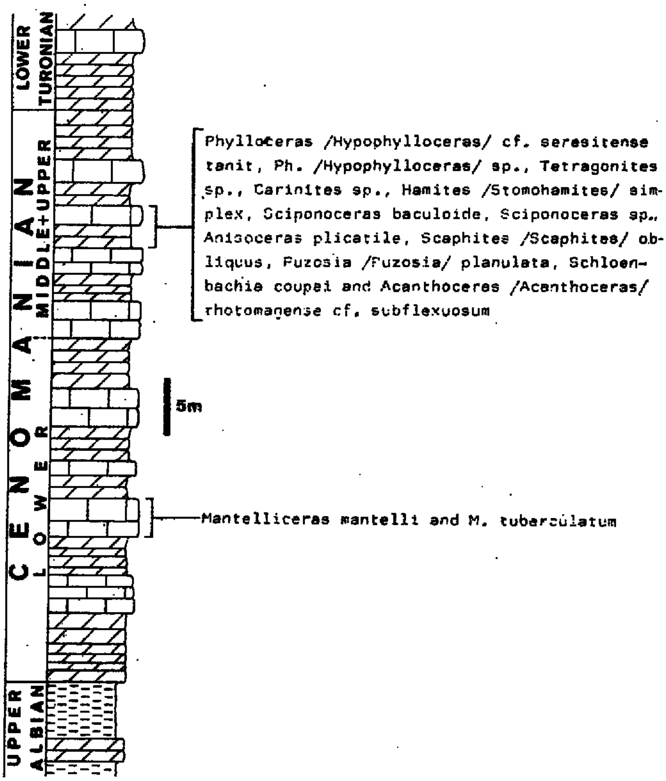


Fig. 9. Cenomanian deposits and ammonite distribution in the Ajmaki section, Dagestan Caucasus, Soviet Union (general profile *after:* Naidin, unpublished data); explanations as for Text-fig. 2

sections (Moskvin 1962, p. 163). The latter observation is a by-product of the untenable assumption of the constant stratigraphic range of *Holaster subglobosus* Leske, which assumption has been refuted by Peake & Hancock (1961), Kennedy (1969), and Marcinowski (1974). In turn, the species *Mantelliceras mantelli* (J. Sowerby) has never been recorded above the Lower Cenomanian as meant within the tripartite subdivision of the stage. The faunal succession observed in various sections in the Dagestan Caucasus indicates that the Lower/Upper Cenomanian boundary *sensu* Moskvin (1959, 1962) most probably lies within the Turrilites costatus Zone (*cf.* Table 1).

The investigated sections at Ajmaki and Rubas-chaj (*cf.* Text-figs 9—10) yielded ammonite taxa known exclusively from either the Lower, or the Middle Cenomanian but nevertheless, the scarcity of the paleontological material does not permit any more precise subdivision of the Cenomanian strata. In the Ajmaki section the Lower Cenomanian rocks contain *Mantelliceras mantelli* (J. Sowerby) and *M. tuberculatum* (Mantell), and the Middle Cenomanian ones *Acanthoceras rhotomagense* cf. *subflexuosum* Spath and *Schloenbachia coupei* (Brongniart) among others. The sedimentary continuity to the Lower Turonian is indicative of the occurrence of the Upper Cenomanian, too (*cf.* Text-fig. 9). This is also the case with the Cenomanian section along the Rubas-chaj river (*cf.* Text-fig. 10) with *Mantelliceras mantelli* (J. Sowerby) and *M. biroi* Collignon (*cf.* Pl. 11, Fig. 4 in the present paper) recorded in its lower part, and *Inoceramus scalprum* Böhm, *Holaster subglobosus* Leske, and *Turrilites costatus* Lamarck (see Moskvin 1959; Naidin & Shimanskij 1959, Pl. 4, Fig. 8) in the upper part. In the latter section the top of the Cenomanian displays some erosional characteristics and the lower part of the Inoceramus labiatus Zone is most probably lacking.

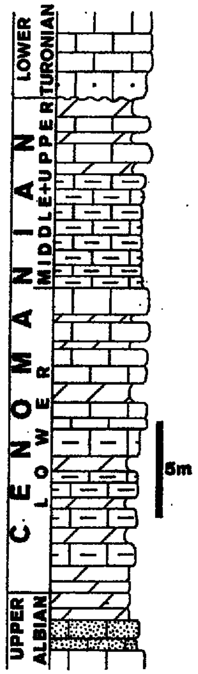
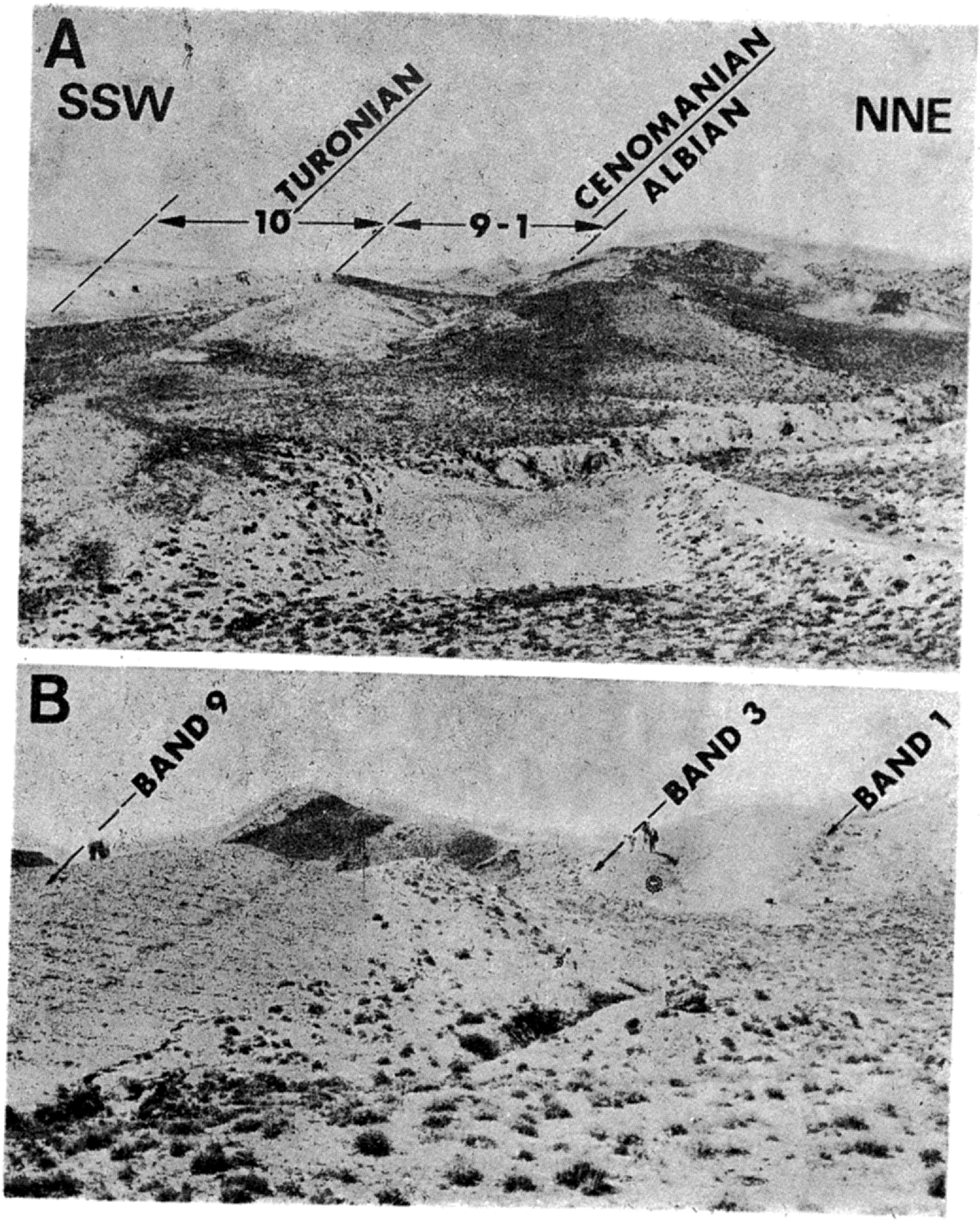


Fig. 10
Cenomanian deposits in the Rubas-chaj section, Dagestan Caucasus, Soviet Union (general profile *after:* Naidin, unpublished data); explanations as for Text-fig. 2

MANGYSHLAK

The best section of the Cenomanian strata is exposed at Sullu-kapy, southern Aktau Chain, southern part of the Mangyshlak anticlinorium (*cf.* Text-figs 11—12), where they dip south-southwestwards.



Exposures of the Albian, Cenomanian and Turonian deposits in the Sullu-kapy section, Mangyshlak, Soviet Union

A — General view of the section; the numbers denote the bands discussed in the text, and used in the profile in Text-fig. 12

B — Uppermost Albian and Cenomanian deposits yielding three horizons of ferro-siliceous nodules with a phosphatic content (Bands *1*, *3*, and *9* in Text-fig. 12)

LITHOLOGY AND AMMONITE DISTRIBUTION

The uppermost Albian/Cenomanian strata are subdivided into ten lithological units.

Band 1. Ferrugineous-siliceous concretions.
Band 2. Orange-yellowish fine-grained sands.
Band 3. Ferrugineous-siliceous concretions embedded within grey silty clays, with an omission surface at the base of the horizon. As documented by a chemical analysis (performed by Z. Jońca, M. Sc.), the concretions are composed mostly of goethite and amorphous silica with P_2O_5, illite, and ?glauconite in minor amounts. Thus, they can hardly be recognized for phosphatic as it was claimed by Trifonov & Burago (1960, pp. 52 and 71).
Band 4. Grey silty clays.

The Bands *3—4* contain lots of ammonites, prefectly preserved in form of ferrugineous-siliceous moulds of the inner parts of phragmocones. The Bands *3—4* are therefore recognized for the *I faunal horizon* (see *occurrence* in the paleontological part of the paper), characterized by mass occurrence of *Schloenbachia* and *Hyphoplites*, abundant *Sciponoceras*, and infrequent mantelliceratids (*cf.* Text-fig. 12).

Band 5. Grey silts with a few ferrugineous-siliceous concretions and an omission surface at the base.
Band 6. Grey silty clays.
Band 7. Grey, highly clayey sands with a few small ferrugineous-siliceous concretions and an omission surface at the base.
Band 8. Grey silty clays.
Band 9. Ferrugineous-siliceous concretions associated with an omission surface. The concretions are indistinguishable in composition from those from the Band *3*.

The Bands *7—9* contain very abundant, perfectly preserved ammonite moulds. The maximum frequency of ammonites is at the top of the Band *7* and in the Band *8*. The Bands *7—9* are recognized for the *II faunal horizon* (see *occurrence* in the paleontological part of the paper), characterized by mass occurrence of *Turrilites costatus* Lamarck, *Schloenbachia, Scaphites,* and *Sciponoceras*, and presence of *Worthoceras*.

Band 10. Weakly lithified, fine-grained, calcareous quartz sandstones with minor amounts of glauconite. A specimen of *Inoceramus labiatus labiatus* (Schlotheim) (identified by Docent K. A. Tröger) was found some 10 m above the top of the Band *9*.

AMMONITE ASSEMBLAGE

The assemblage includes species of wide geographic distribution, indicative of the Lower and Middle Cenomanian (*cf.* Text-fig. 12). It is predominated by the genus *Schloenbachia*, very common in the *I* and *II* faunal horizons. Representatives of the genera *Schloenbachia* and *Hyphoplites* account for more than a half of the assemblage in the *I* faunal horizon (Bands *3—4*). In the *II* faunal horizon (Bands *7—9*), *Turrilites* *costatus* Lamarck and *Schloenbachia* are more or less equally abundant and account jointly for 70—80% of the total number of ammonite specimens. The species *Schloenbachia varians* (J. Sowerby) ranges up into the Middle Cenomanian in the Sullu-kapy section (*cf.* Text-fig. 12), as it is also the case in the Hoppenstedt quarry and the Southwestern Crimea Highland. The abundance of *Schloenbachia* and *Hyphoplites* are indicative of Boreal affinities of the ammonite fauna. It is therefore noteworthy

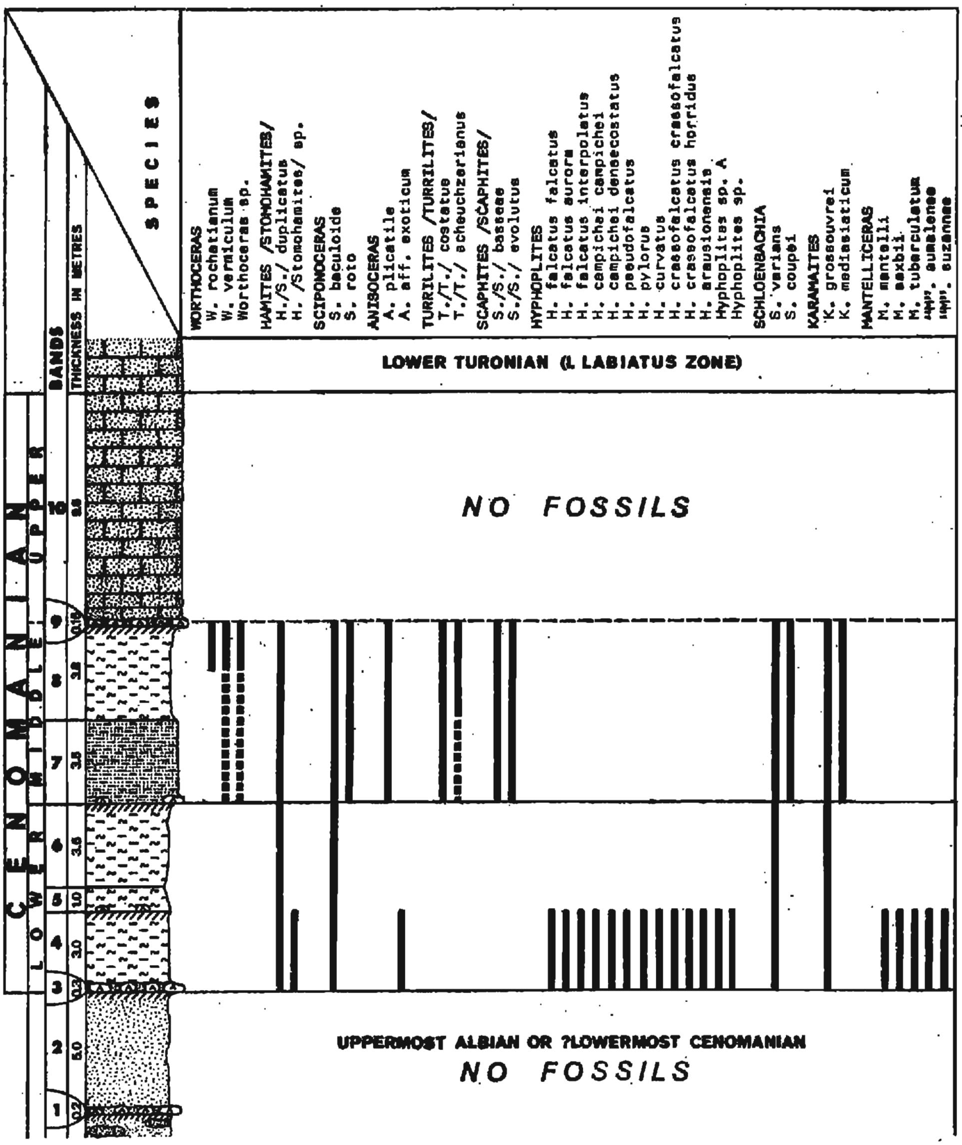


Fig. 12. Distribution of Cenomanian ammonites in the Sullu-kapy section, Mangyshlak (general profile *after:* Zhelezko, unpublished data); explanations as for Text-fig. 2

that the assemblage includes also a few Mediterranean placenticeratids of the genus *Karamaites* and heteromorphs of the genus *Worthoceras;* moreover, the Middle Cenomanian strata of the Sullu-kapy section contain lots of specimens attributable to *Scaphites basseae* Collignon, which species was thus far widely known from Madagascar and North Africa but not from Mid-Asia.

STRATIGRAPHY

The lower boundary of the Cenomanian is marked in the Sullu-kapy section by the first appearance of the genera *Schloenbachia, Mantelliceras,* and *Hyphoplites* at the base of the Band *3*. This boundary may actually lie within the Lower Cenomanian, as indicated by the co-occurrence of such Lower Cenomanian species as *Mantelliceras tuberculatum* (Mantell), *M. mantelli* (J. Sowerby), *M. saxbii* (Sharpe), *"M." aumalense* (Coquand), and *"M." suzannae* (Pervinquière), with taxa recorded both in the uppermost Albian and the Lower Cenomanian, viz. *Hyphoplites falcatus interpolatus* Wright & Wright, *H. falcatus aurora* Wright & Wright, *H. campichei campichei* Spath, *H. campichei densecostatus* Renz, *H. pylorus* Wright & Wright. This undermines Trifonov & Burago's (1960, p. 71) assertion that the Albian/Cenomanian boundary is to be traced at the base of the Band *1*, that is at the first appearance of ferrugineous--siliceous concretions, which assertion follows from purely lithological premises and an assumption that non-fossiliferous concretions are to be attributed to the same stage as the overlying ammonite-bearing ones. No ammonites have been found in the Bands *5—6* but nevertheless, those strata are here assigned to the Lower Cenomanian because of their position in the section (*cf.* Text-fig. 12). The lower boundary of the Middle Cenomanian is marked by the mass appearance of *Turrilites costatus* Lamarck and *Scaphites basseae* Collignon with the genera *Mantelliceras* and *Hyphoplites* being absent; it is at the base of the Band 7. The Middle Cenomanian ammonite assemblage is dominated by *Turrilites costatus* Lamarck and the schloenbachiids, which suggests that those strata (*II* faunal horizon or Bands *7—9*) represent only the Turrilites costatus Zone. This supposition is corroborated by the absence of *Turrilites acutus* Passy, large-sized representatives of the genus *Acanthoceras,* and *Calycoceras* of the *newboldi* group (*cf.* Kennedy & Juignet 1975, Juignet & Kennedy 1976, Kennedy & Hancock 1976). One may claim that a stratigraphic gap is associated with the concretion bed (Band *9*) and the omission surfaces at its bottom and top. That gap comprising the middle to upper Middle Cenomanian and possibly also a part of the Upper Cenomanian is recognizable all over the western Mangyshlak (northern and southern Aktau Chains); its stratigraphic range is indicated by the absence from that area of any doubtless paleontologic evidence for strata of younger age than the Turrilites costatus Zone (*cf.* Trifonov & Burago 1960, Trifonov & Vasilenko 1963, Schmidt & *al.* 1973).

The sandstones of the lower part of the Band *10* are arbitrarily assigned to the Upper Cenomanian; the lower boundary of the latter substage cannot be recognized due to the lack of any macrofossil remains (*cf.* Text-fig. 12). The Cenomanian/Turonian boundary is traced at the first appearance of *Inoceramus labiatus labiatus* (Schlotheim), some 10 m above the base of the Band *10.* Previously, that boundary was traced at the top of the Band *10* (cf. Trifonov & Burago 1960, p. 71) which exceeds 20 m in thickness, but the recent finding of the index inoceramid species by Professor D. P. Naidin has permitted its more precise recognition.

The strata overlying in the Sullu-kapy section the paleontologically documented Middle Cenomanian and underlying the Inoceramus labiatus Zone are non-fossiliferous. The geological situation is exactly like in the Hoppenstedt quarry and the Southwestern Crimea Highland (*cf.* Text--figs 2 and 6); furthermore, the phenomenon is independent of facies, as it occurs in marly-carbonate deposits as well as in sandy ones.

Schmidt & *al.* (1973) subdivided the Cenomanian of Mangyshlak into two substages (*cf.* Table 1). In that subdivision, the base of the Lower Cenomanian is marked by the appearance of *Schloenbachia varians* (J. Sowerby) and *Inoceramus crippsi* Mantell, as in other regions, and the substage is subdivided into two zones called as the Analogues of the Neohibolites ultimus and Mantelliceras mantelli Zones; the zones are claimed to be correlatable with their equivalents in the Kopet-Dag. The present author is of the opinion that the available paleontological evidence is insufficient to permit an unequivocal definition of the boundary between the two zones, which makes the proposed correlation precarious (this is why it is marked by a dashed line in Table 1 of the present paper). According to Schmidt & *al.* (1973), the Lower/Upper Cenomanian boundary is associated with a stratigraphic gap comprising the lowermost part of their Upper Cenomanian. Consequently, such undoubtedly Middle Cenomanian species as *Euomphaloceras cunningtoni* (Sharpe), *Acanthoceras rhotomagense* (Brongniart), and *Turrilites costatus* Lamarck first appear in Mangyshlak above the lower boundary of the Turrilites costatus Zone as meant in the present paper (*cf.* Table 1). The Cenomanian/Turonian boundary is documented there by several findings of *Inoceramus labiatus* (Schlotheim).

KOPET-DAG

The Cenomanian is represented by clastics (claystones, siltstones, sands, and sandstones) of 100—700 m in thickness in the Kopet-Dag, which range makes up a prolongation of the Caucasus. The Cenomanian strata contain ammonites which are most commonly known from northwestern Europe, as well. The ammonite assemblage shows Boreal affinities with representatives of the genera *Hyphoplites* and *Schloenbachia* being dominant forms in the Lower, and Lower to middle Middle Cenomanian, respectively (*cf.* Atabekyan 1960, 1961; Manija 1974).

STRATIGRAPHY

Atabekyan (1961) divided the Cenomanian of the Kopet-Dag into two substages; the lower one including the Beds with *Neohibolites ultimus* and the Mantelliceras mantelli Zone, and the upper one further subdivided into the Euomphaloceras euomphalum and Acanthoceras rhotomagense Zones. The Albian passes continuously into the Cenomanian, the interstage boundary being marked by the first appearance of *Schloenbachia varians* (J. Sowerby) and its varieties and *Neohibolites ultimus* (d'Orbigny) (*see* Atabekyan 1961, Fig. 3; Manija 1974, Fig. 2). In the upper part of the Lower Cenomanian of Atabekyan, *Schloenbachia coupei* (Brongniart) appears in addition to *S. varians*, as well as numerous representatives of the genera *Hyphoplites* and *Mantelliceras*. This is the Mantelliceras mantelli Zone of Atabekyan, more or less equivalent to the Mantelliceras ex gr. dixoni Zone of northwestern Europe. The interrelationship of the two zones cannot be recognized more precisely because only the upper boundary of the Mantelliceras mantelli Zone of Atabekyan is well defined in the Kopet-Dag, as it is indicated by the stratigraphic distribution of ammonites in the sections investigated by Atabekyan (1961).

The Mantelliceras mantelli/Euomphaloceras euomphalum Zone boundary of Atabekyan is isochronous with the Mantelliceras ex gr. dixoni/ /Turrilites costatus Zone boundary of northwestern Europe (*cf.* Table 1 in the present paper). In fact, the Lower Cenomanian genera *Mariella, Mantelliceras,* and *Hyphoplites* disappear at that boundary replaced with the acanthoceratids, viz. *Euomphaloceras* of the *inerme* group and ?*Acanthoceras confusum* (Guéranger) [? = *A. hippocastanum* Sow. of Atabekyan (1961), and Manija (1974)], and *Turrilites costatus* Lamarck. The above list of the ammonite taxa of the Euomphaloceras euomphalum Zone of Atabekyan indicates that the zone is equivalent to the Turrilites costatus and T. acutus Zones of northwestern Europe (*cf.* Table 1). Manija (1974) further subdivided the Euomphaloceras euomphalum Zone of Atabekyan into the Karamaites grossouvrei and Mesogaudryceras leptonema Subzones. However, these are only local biostratigraphic units; they are insufficiently documented paleontologically, and the index species are known also from the Lower Cenomanian outside the Kopet--Dag.

The lower boundary of the Acanthoceras rhotomagense Zone of Atabekyan, marked by the co-occurrence of *Acanthoceras* of the *rhotoma-*

gense group and *Acanthoceras* cf. *jukesbrownei* Spath, is more or less equivalent to the base of the Acanthoceras jukesbrownei Zone of northwestern Europe (*cf.* Table 1). In turn, the upper boundary of that zone is marked by the base of the phosphorite horizon with *Actinocamax plenus* (Blainville), the latter horizon being attributed by Atabekyan (1961) to the Lower Turonian. It is however to be noted that *Actinocamax plenus* (Blainville) occurs in the Kopet-Dag (*see* Atabekyan 1961, pp. 78 and 81; Dzhaborov & *al.* 1970) below the first appearance of *Inoceramus labiatus* (Schlotheim) and hence, strata containing that belemnite species are to be assigned to the Cenomanian instead of the Lower Turonian. Under such meaning, the Acanthoceras rhotomagense Zone of Atabekyan is equivalent to the upper Middle Cenomanian and the whole Upper Cenomanian in the tripartite, European subdivision of the stage (*cf.* Table 1).

As demonstrated by Manija (1974), the sandy deposits ranging from 10 to 66 m in thickness, overlying the strata with last acanthoceratids noted by Atabekyan (1961) and underlying strata with first specimens of *Actinocamax plenus* (Blainville), contain an ammonite assemblage including *Protacanthoceras kopetdagensis* Manija, *P. bunburianum* (Sharpe), *Calycoceras bathyomphalum* (Kossmat), *C.* cf. *bruni* (Fabre), and *Worthoceras vermiculum* (Shumard) [= *W. rochatianum* (Orb.) of Manija (1974)] among others. Those strata were recognized by Manija (1974) for the Protacanthoceras kopetdagensis Zone. When that zone is expanded upwards to include also the strata with *Actinocamax plenus* (Blainville), as it is advocated by the present author, it becomes equivalent to the upper part of the Eucalycoceras pentagonum Zone and the whole Sciponoceras gracile Zone of northwestern Europe (Table 1). One should however keep in mind that submarine non-depositional and/or erosional surfaces are commonly associated with the Cenomanian/Turonian boundary in the Kopet-Dag, which results in a reduction in thickness of the Inoceramus labiatus Zone (*cf.* Atabekyan 1961, Text-fig. 6).

SYSTEMATIC DESCRIPTION OF THE AMMONITES

The investigated collection includes over 3,000 ammonite specimens, a thousand of which were biometrically studied. The ammonite-bearing localities are spread over some 3,200 km in distance, in platform as well as in Alpine geosynclinal areas. This is advantageous because a recognition of intraspecific variability is allowed over various facies belts or even zoogeographic provinces.

The accepted systematic arrangement of high-rank taxa (down to the familial level) follows Wright (1957), but with some more or less important modifications introduced by Kullmann & Wiedmann (1970) and Wiedmann (1972). In general, high-rank taxa are not commented in the present paper, whereas genera and subgenera usually are provided with short remarks.

Sexual dimorphism has been recognized only in very well and completely preserved specimens including representatives of the genera *Sciponoceras* Hyatt, *Scaphites* Parkinson, and *Puzosia* Bayle, among others. In those cases, the description takes both micro- and macroconchs into account, and the two morphotypes are ascribed to a single species (*cf.* Makowski 1962a, b).

The genus *Schloenbachia* Neumayr (over 1,000 specimens in the collection) is dealt with in less detail than the others (only species lists are given for particular localities) because it is going to be monographed by Dr. J. M. Hancock (King's College, London).

For most of the investigated species the following measurements are given:

D — shell diameter, in *mm*;
Wh — whorl height, as percent proportion of diameter;
Wb — whorl breadth (or thickness), as percent proportion of diameter;
U — umbilical breadth, as percent proportion of diameter;
R — rib number per whorl (where only a whorl fragment is considered, this is pointed out in parentheses);
Rp — primary ribs;
Rs — secondary ribs.

Biometry for *Worthoceras* and *Scaphites* is as follows:

D — the greatest diameter of complete specimen (shaft and hook), in *mm*;
Wb — maximum breadth (or thickness) of shaft and hook, in *mm*;
d — diameter of spiral portion, in *mm*;
wh — whorl height, as percent proportion of diameter (*d*);
wb — whorl breadth (or thickness), as percent proportion of diameter (*d*);
u — umbilical breadth, as percent proportion of diameter (*d*).

The measurement exacticude is 1 percent in large-sized specimens, and 0.1 percent in small-sized ones.

The investigated ammonites from GDR (Subhercynian Cretaceous and Saxony) are stored at the museum of the Bergakademie Freiberg, GDR; the remainder of the collection is housed at the Institute of Geology of the Warsaw University.

Class **CEPHALOPODA** Cuvier, 1797
Subclass **AMMONOIDEA** Zittel, 1884
Order **Phylloceratida** Arkell, 1950
Superfamily **Phyllocerataceae** Zittel, 1884
Family **Phylloceratidae** Zittel, 1884
Subfamily **Phylloceratinae** Zittel, 1884
Genus *PHYLLOCERAS* Suess, 1865
Subgenus *HYPOPHYLLOCERAS* Salfeld, 1924
(Type species: *Phylloceras onoense* Stanton, 1895)

General remarks. — The genus *Phylloceras* Suess and its subgenera are characterized concisely and comprehensively by Wiedmann (1962a, b, 1964; Wiedmann & Dieni 1968). In the investigated collection the subgenus *Hypophylloceras* Salfeld is represented by only a few specimens derived chiefly from the geosynclinal areas, except for a single specimen of *Ph. (H.) seresitense* cf. *tanit* Pervinquière [= *Ph. (H.) seresitense seresitense* Pervinquière of Marcinowski 1974, p. 167] found in the platform area.

Occurrence. — The subgenus *Hypophylloceras* Salfeld shows a world-wide distribution, being common in the Mediterranean and infrequent in the Boreal Realm and the Western Interior of North America. It ranges from the Valanginian to Maastrichtian.

Phylloceras (Hypophylloceras) seresitense seresitense Pervinquière, 1907 (Pl. 1, Fig. 1)

1907. *Ph. Velledae* var. *Seresitensis*; Pervinquière, p. 52.
1910. *Phylloceras Velledae* Michelin, var. *Seresitensis* Pervinquière; Pervinquière, p. 9, Text-fig. 2, Pl. 1, Figs 1—3.
1956. *Hyporbulites seresitensis* Pervinquière var. *raynaudiensis* nov. var.; Collignon, pp. 16—17, Pl. 4, Fig. 1.
1959c. *Neophylloceras seresitense* (Pervinquière); Matsumoto, pp. 55—58, Text-fig. 3, Pl. 12, Figs 4—5.
1962a. *Hypophylloceras seresitense* (Pervinq.); Wiedmann, pp. 249—250 and 262, Pl. 16, Fig. 1.
1962b. *Hypophylloceras seresitense seresitense* (Perv.); Wiedmann, pp. 142—144, Text-fig. 8, Pl. 8, Figs 1—2.
1964. *Ph. (H.) seresitense seresitense* Perv.; Wiedmann, pp. 221—224, Text-fig. 52, Pl. 15, Fig. 4, and Pl. 21, Fig. 1 [*cum syn.*].
non 1974. *Phylloceras (Hypophylloceras) seresitense seresitense* Pervinquière, 1907; Marcinowski, pp. 167—168, Pl. 31, Fig. 2 [=*Ph. (H.) seresitense* cf. *tanit* Pervinquière].
1976. *Phylloceras (Hypophylloceras) seresitense* Pervinquière; Kennedy, p. 22, Pl. 3, Fig. 3.
1977a. *Phylloceras (Hypophylloceras) seresitense seresitense* Pervinquière; Kennedy & Klinger, pp. 364—365, Pl. 4, Fig. 6, Pl. 6, Fig. 4, Pl. 7, Fig. 4, and Pl. 9.

Material: Relatively well preserved specimen with fragmentarily discernible sutural line, No. *115.4954*.

Table 3

Specimen No.	D mm	Wh %	Wb %	U %	$\frac{Wb}{Wh}$
115.4954	38.7	60	39	6	0.65

Remarks. — The flat, subparallel whorl flanks and the narrow and deep umbilicus make the investigated specimen very close to *Phylloceras (Hypophylloceras) seresitense seresitense* Pervinquière (*cf.* Wiedmann 1962b, p. 142; Wiedmann 1964, p. 221; Wiedmann & Dieni 1968, p. 26).

The specimen described previously by the present author (Marcinowski 1974, Pl. 31, Fig. 2) under the name *Ph. (H.) seresitense seresitense* Pervinquière is to be assigned to *Ph. (H.) seresitense* cf. *tanit* Pervinquière because its umbilical breadth approximates 10% of the shell diameter (*cf.* Kennedy & Klinger 1977a, p. 365). Its identification remains however tentative because the specimen includes only the inner whorls which are wider ($Wb : Wh = 0.86$) than usually in the latter subspecies.

Occurrence. — Lower Cenomanian, MGU Station [= section at the Field Station of the Moscow University at the northern slope of the Mt. Selbukhra, section *4* in Text-fig. 5], Band *IV—1* (Bed *1*), Crimea (*cf.* Text-fig. 6).

The subspecies *Phylloceras (Hypophylloceras) seresitense seresitense* Pervinquière has been recorded in the Upper Aptian of Mallorca Island, and in the Albian to Cenomanian of southern France, Switzerland, northern Spain, Sardinia, Tunisia, Algeria, Madagascar, the Zululand, southern India, and Alasca.

Phylloceras (Hypophylloceras) cf. *seresitense tanit* Pervinquière, 1907 (Pl. 1, Fig. 2)

Material: Four flattened specimens, Nos *93.7751—3* (the illustrated one), *117.7757—3*, *118.82a—1*, and *118.82a—2*.

Remarks. — The investigated specimens differ from the above described subspecies *seresitense* in their more densely spaced, finer striation and especially in their much wider umbilicus (U=9—13.5), which makes them close to *Phylloceras (Hypophylloceras) seresitense tanit* Pervinquière. However, they can be only tentatively identified because of their poor preservation state.

Occurrence. — Nos *93.7751—3* and *117.7757—3:* Lower Cenomanian, MGU Station, Band *IV—1* (Bed *1*), Crimea (*cf.* Text-fig. 6); Nos *118.82a—1* and *118.82a—2:* Middle Cenomanian (along with *Acanthoceras rhotomagense* cf. *subflexuosum* Spath), Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

Phylloceras (Hypophylloceras) sp.

In addition to the above described phylloceratid specimens, the collection also includes 10 specimens of *Phylloceras (Hypophylloceras)* sp. These are whorl fragments or strongly deformed phragmocones collected in the Lower to Middle Cenomanian of the southwestern Crimea Highland and in the Middle Cenomanian at Ajmaki, Dagestan Caucasus.

Order **Lytoceratida** Hyatt, 1889
Suborder **Lytoceratina** Hyatt, 1889
Superfamily **Tetragonitaceae** Hyatt, 1900
Family **Gaudryceratidae** Spath, 1927

Remarks. — The systematic position of the family Gaudryceratidae and phylogenetic relationships among the constituent genera are comprehensively discussed by Wiedmann (1962b, pp. 147—150) and widely accepted by other authors. Wiedmann (1962b) distinguished also the subfamilies Gaudryceratinae Spath, Vertebritinae Wiedmann, and Gabbioceratinae Breistroffer, which subdivision appears disputable because of the insignificance of morphological differences (*cf.* Cooper 1978, Kennedy & Klinger 1979).

Genus *GAUDRYCERAS* de Grossouvre, 1894 (Type species: *Ammonites mitis* von Hauer, 1866)

Remarks. — The genus *Gaudryceras* de Grossouvre is here meant as by Kennedy & Klinger (1979) who diagnosed it as follows (p. 128):
„Typically evolute, early whorls depressed, slowly expanding, later whorls compressed, expanding more rapidly. Ornament consists of lirae, flexuous or branched, fine and wire--like throughout ontogeny or coarsening and bunching on the outer whorl. Constrictions are present on the internal mould, being marked on the shell by faint collars and depressions. Suture with large bifide lobes and saddles, suspensive lobe typically retracted, with several auxiliaries".

Kennedy & Klinger (1979, p. 128) agree with Wright (1957, p. *L200*) and Matsumoto (1959b, pp. 137 and 141—142; 1959c, pp. 72—73) that the genera *Mesogaudryceras* Spath and *Anagaudryceras* Shimizu are to be regarded as distinct taxa. This contrasts to the opinion of Wiedmann (1962b, p.156) who included the latter two names to the synonymy of the genus *Gaudryceras* de Grossouvre.

Three species groups can be distinguished in the considered genus, different from one another in the nature of adult ornamentation. The species *G. stefaninii* Venzo, 1936, which is described below, is representative of the group of *G. mite* von Hauer, 1866, „where fine, equal ribs are present throughout ontogeny" (Kennedy & Klinger 1979, p. 129).

Occurrence. — The genus *Gaudryceras* de Grossouvre shows a world-wide distribution. It has been recorded in the Upper Albian to Maastrichtian of southern Europe, southern and northern Africa and Madagascar, Asia (Middle East, southern India, Japan, Sakhalin Island, and Kamchatka), North America (Alasca, British Columbia, and California), South America (Chile and Patagonia), New Zealand, and Antarctic and Arctic regions.

Gaudryceras stefaninii Venzo, 1936 (Pl. 1, Figs 14—17)

1979. *Gaudryceras stefaninii* Venzo; Kennedy & Klinger, pp. 130—133, Pl. 1, Figs 2, 5, 8, and Pl. 2, Fig. 1 [*cum syn.*].

Material: Five deformed moulds, Nos *113.12* (Pl. 1, Fig. 14), *92.7009a* (Pl. 1, Fig. 15), 95.491a—2/3 (Pl. 1, Fig. 16), *179.6755* (Pl. 1, Fig. 17), and *107.491a—3.*

Remarks. — The specimens Nos *113.12* (Pl. 1, Fig. 14), *92.7009a* (Pl. 1, Fig. 15), and *179.6755* (Pl. 1, Fig. 17) show fine, dense, mainly singular lirae, onset at the umbilical wall and inclined forwards, but slightly bent backwards after having passed the umbilical edge. The lirae are the most conspicuous at the whorl flank, whereas they become subdivided into several extremely fine striae of *Vertebrites* type in proximity of the ventro-lateral shoulder; this striation is hardly discernible at the ventral whorl side, as figured also by Kennedy & Klinger (1979, Pl. 1, Fig. 2d—e). Three fine, prorsiradiate, shallow constrictions appear at a half whorl in the specimen No. *113.12.* The above described ornamentation is characteristic of the inner whorls (up to 35 mm in diameter) of *G. stefaninii* Venzo (*cf.* Kennedy & Klinger 1979, p. 133).

The specimen No. *95.491a—2/3* (Pl. 1, Fig. 16) is a phragmocone (the sutural line is fragmentarily preserved) at the diameter of some 70 mm. Its lirae are more conspicuous than those of more inner whorls, but their outline and nature at the ventral side cannot be recognized because of the poor preservation state. A collar-like, lirate rib occurs at the outermost part of the specimen.

Occurrence. — Nos *95.491a—2/3* and *107.491a—3:* Middle Cenomanian (along with *Mesogaudryceras rarecostatus* Balan), Bielogorsk, Crimea; Nos *92.7009a, 113.12,* and probably *179.6755:* Middle Cenomanian, MGU Station, Band *IV—2,* Crimea (*cf.* Text-fig. 6).

The species *Gaudryceras stefaninii* Venzo has been reported from the Albian to Lower Cenomanian of Madagascar, and the Lower to Middle Cenomanian of the Zululand.

Gaudryceras sp.

Material: Deformed whorl fragment, No. *83a.6027—15.*

Description. — The whorl is ornamented with widely spaced, singular, distinct, inclined forwards lirae. The lirae are fine at the umbilical wall, coarsening at the whorl flank and passing unchanged on the rounded venter. There are four shallow, indistinct, lirate constrictions (per one third of the whorl) at the whorl flank and venter.

Remarks. — The specimen differs from its congeners in its widely spaced, distinct lirae and numerous constrictions.

Occurrence. — Middle Cenomanian, northeastern slope of the Mt. Selbukhra, Band *IV—2* (Bed 4), Crimea (*cf.* Text-fig. 6).

Genus *ANAGAUDRYCERAS* Shimizu, 1934
(Type species: *Ammonites sacya* Forbes, 1846; subjective synonym of *Ammonites buddha* Forbes, 1846)

Remarks. — The genus *Anagaudryceras* Shimizu differs from the above discussed genus *Gaudryceras* de Grossouvre mostly in its less coarse lirae, especially at the adult stages, strongly projecting on the venter (*cf.* Howarth 1965, p. 357; Kennedy & Klinger 1979, pp. 129 and 144).

Occurrence. — The genus *Anagaudryceras* Shimizu shows a world-wide distribution, having been recorded in the Upper Albian to Maastrichtian of Antarctic regions, New Zealand, southern and northern Africa and Madagascar, Europe (France, GFR, Austria, Rumania, Crimea), Asia (Kopet-Dag, Sakhalin Island, Kamchatka, southern India and Japan), and North America (Alasca, British Columbia, California).

Anagaudryceras cf. *cassisianum* (d'Orbigny, 1850)
(Pl. 1, Fig. 13)

1978. *Anagaudryceras* cf. *cassisianum* (d'Orbigny, 1850); Cooper, pp. 65—67, Fig. 10J.
Material: Diagenetically flattened whorl fragment, No. *88.7754—8*.

Description. — The whorl is ornamented with fine, densely spaced lirae, onset at the umbilical wall and inclined forwards. The lirae bifurcate or intercalar lirae appear at the umbilical edge where they incline backwards to be almost rectiradiate at the whorl flank. There is also a collar-like rib parallel to the lirae; it is hardly discernible because of a mechanical damage.

Remarks. — The specimen is indistinguishable in ornamentation from a fragment of mature individual described and figured by Cooper (1978, pp. 65—67, Fig. 10J).

Occurrence. — Middle Cenomanian, MGU Station, Band *IV-2* (Bed 5), Crimea (*cf.* Text-fig. 6).

The form *Anagaudryceras* cf. *cassisianum* (d'Orbigny) has been recorded in the uppermost Cenomanian to lowermost Turonian of Salinas, Angola.

Genus *MESOGAUDRYCERAS* Spath, 1927
(Type species: *Ammonites leptonema* Sharpe, 1855)

Remarks. — The genus *Mesogaudryceras* Spath differs from *Gaudryceras* de Grossouvre in its more compressed and involute, finely lirate whorls without any constrictions (Wright 1957, p. *L200*; Cooper 1978, p. 60; Kennedy & Klinger 1979, p. 129).

Occurrence. — The genus *Mesogaudryceras* Spath has thus far been reported only from the Lower Cenomanian of Greenland and southern England, and the Middle Cenomanian of southern France and the Soviet Union (Crimea, Kopet-Dag).

Mesogaudryceras leptonema (Sharpe, 1855)
(Pl. 1, Figs 8 and 10*a*)

1855. *Ammonites leptonema*, Sharpe; Sharpe, pp. 32—33, Pl. 14, Fig. 3.
1895. *Lytoceras (Gaudryceras) leptonema* Sharpe; Kossmat, p. 115.
1951. *Mesogaudryceras leptonema* (Sharpe); Wright & Wright, p. 12.
?1954. *Mesogaudryceras* cf. *leptonema* (Sharpe); Donovan, p. 23.
1959. *Gaudryceras sacya* (Forbes) var.; Naidin & Shimanskij, p. 178, Pl. 15, Figs 4—5 (non Fig. 6 = *Mesogaudryceras rarecostatus* Balan).

1971. *Mesogaudryceras leptonema* (Sharpe); Kennedy, p. 4, Pl. 1, Figs 10—11.
1974. *Mesogaudryceras leptonema* (Sharpe); Manija, p. 93.

Material: Diagenetically flattened moulds and imprints, Nos *96.536* (Pl. 1, Fig. 8), *85.7758a* (Pl. 1, Fig. 10*a*), *97.536*, and *98.536*.

Remarks. — The specimens No. *96.536* (Pl. 1, Fig. 8) and No. *85.7758a* (Pl. 1, Fig. *10a*) are moderately evolute, covered with fine, sharp, and flexuous lirae (45 and ca 38 in number per half whorl, respectively) which are narrower than the interspaces. Thus, they show characteristics typical of the species.

The specimens attributed by Naidin & Shimanskij (1959, p. 178, Pl. 15, Figs. 4—5) to *Anagaudryceras sacya* (Forbes) show distinct lirae but not constrictions and hence, they are to be ascribed to *M. leptonema* (Sharpe). In fact, the lirae are hardly discernible even in perfectly preserved specimens of *A. sacya* (Forbes), which name is a subjective synonym of *A. buddha* (Forbes), as illustrated by McLearn (1972), Matsumoto & *al.* (1972; under the name *Kossmatella enigma*), and Kennedy & Klinger (1979).

Occurrence. — Nos *96.536*, *97.536*, and *98.536*: Middle Cenomanian, Bielogorsk, Crimea; No: *85.7758a:* Middle Cenomanian, southern slope of the Mt. Selbukhra (=section *3* in Text-fig. 5), Band V (lower part), Crimea (*cf.* Text-fig. 6).

The species *Mesogaudryceras leptonema* (Sharpe) has been recorded in the Cenomanian of England, supposedly Lower Cenomanian of eastern Greenland, and Middle Cenomanian of France and the Soviet Union (Kopet-Dag).

Mesogaudryceras rarecostatus Balan, 1979
(Pl. 1, Figs 9, 10*b*, and 11—12)

1959. *Gaudryceras sacya* (Forbes) var.; Naidin & Shimanskij, p. 178, Pl. 15, Fig. 6 [non Figs 4—5 = [*Mesogaudryceras leptonema* (Sharpe)].
1979. *Mesogaudryceras rarecostatus* Balan, sp. nov.; Balan, pp. 40—41, Pl. 2.

Material: Diagenetically deformed moulds and imprints, Nos *100.5071* (Pl. 1, Fig. 9), *85.7758b* (Pl. 1, Fig. 10*b*), *94.491a—1* (Pl. 1, Fig. 11), *99.9145* (Pl. 1, Fig. 12), *82.6027—1a*, *83.6027—15*, *84.491a—4*, *84a.491a—4*, *102.7755—8*, *103.7755—8*, *109.9090*, and probably *105.7756—6*.

Remarks. — The investigated specimens differ from their close relatives attributable to *Mesogaudryceras leptonema* (Sharpe) (*cf.* Kennedy 1971, Pl. 1, Fig. 10) in their coarser and much less densely spaced lirae, the number of which per whorl may be twice smaller than in the latter species (*cf.* Pl. 1, Fig. 11). This is also the case with the specimen misidentified by Naidin & Shimanskij (1959, Pl. 15, Fig. 6) as *Anagaudryceras sacya* (Forbes) = *A. buddha* (Forbes). The ornamentation is diagenetically destroyed, and hence the lirae are relatively indistinct, in the specimen No. *100.5071* (Pl. 1, Fig. 9). The investigated specimens are entirely consistent with *Mesogaudryceras rarecostatus* as diagnosed by Balan (1979, pp. 40—41). There are no more than 57 distinct and widely spaced lirae per whorl in *M. rarecostatus*, whereas the number of lirae per whorl approximates 80 in *M. leptonema*. The specimens illustrated by Naidin & Shimanskij (1959, Pl. 15, Figs 4—5) and included by Balan (1979) to the synonymy of *M. rarecostatus* are rather finely and densely lirate (they show much more than 57 lirae per whorl), which makes them close to *M. leptonema* rather than to the species under discussion.

Occurrence. — Nos *84.491a—4*, *84a.491a—4*, *94.491a—1*: Middle Cenomanian, Bielogorsk, Crimea; Nos *82.6027—1a*, *83.6027—15*, *102.7755—8*, *103.7755—8*: Middle Cenomanian, MGU Station and southern slope of the Mt. Selbukhra, Band *IV-2* (Bed 4), Crimea; No. *105.7756—6*: Middle Cenomanian, MGU Station, Band *IV-2*

(Bed 5), Crimea; Nos *85.7758b* and *99.9145*: Middle Cenomanian, southern slope of the Mt. Selbukhra, Band V (lower part), Crimea (*cf.* Text-fig. 6); No. *100.5071:* Cenomanian, marls high in the Mender ravine, Crimea; No. *109.9090*: Cenomanian, Belbek river at Kuybyshevo, southwestern Crimea Highland.

The species *Mesogaudryceras rarecostatus* Balan has thus far been reported only from the Cenomanian of the southwestern Crimea Highland where it seems to be confined to the Middle Cenomanian, as is the case also with *M. leptonema* (Sharpe).

Genus *ZELANDITES* Marshall, 1926
(Type species: *Zelandites kaiparaensis* Marshall, 1926)

Remarks. — The genus *Zelandites* Marshall resembles *Mesogaudryceras* Spath in its involute shell with high arched venter at the adult stages, but it differs from the latter in its much finer or even absent lirae, smaller-sized adult shell, and the presence of constrictions.

Occurrence. — The genus *Zelandites* Marshall shows a world-wide distribution, having been recorded in the Lower Albian to Lower Maastrichtian of southern Europe (northern Spain, southern France, the Balearis, Sardinia, Crimea), northern and southern Africa and Madagascar, Asia (Kopet-Dag, southern India, Japan), North America (Alasca, British Columbia, California), South America (Chile), and New Zealand.

Zelandites dozei dozei (Fallot, 1885)
(Pl. 1, Figs 5—7)

1908. *Gaudryceras Dozei* Fallot sp.; Jacob, pp. 16—17, Pl. 2, Fig. 12.
1910. *Lytoceras (Gaudryceras) Dozei* Fallot; Pervinquière, pp. 14—15, Pl. 1, Figs 11—17 (?non Fig. 18 = *Zelandites dozei schroederi* Wiedmann).
1979. *Gaudryceras (Zelandites) dozei dozei* (Fallot, 1885); Scholz, pp. 51—53, Text-fig. 14, Pl. 10, Figs 3—4.

Material: Moderately preserved moulds, Nos *106.7751—6* (Pl. 1, Fig. 5), *101.2144—1* (Pl. 1, Fig. 6), *184.6008—9a* (Pl. 1, Fig. 7), and *87.9106—1*.

Table 4

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh
101.2144-1	16.3	37		39	
106.7751-6	15.7	41	32	34	0.78
184.6008-9a	20.0	42		35	

Remarks. — The investigated specimens are consistent with the descriptions and illustrations referred to in the synonymy, except for their shallow and poorly developed constrictions, hardly discernible in the photos. It is however to be noted that not all individuals of *Zelandites dozei* (Fallot) show well developed constrictions (*cf.* Jacob 1908, Pl. 2, Fig. 12; Pervinquière 1910, Pl. 1, Fig. 17). This is also the case with *Z. odiensis* (Kossmat), some individuals of which show no constrictions (*cf.* Kossmat 1895, Pl. 18, Fig. 1; Kennedy & Klinger 1979, Pl. 14, Fig. 4), while others display indistinct constrictions (*cf.* Collignon 1963, pp. 20—21, Pl. 249, Fig. 1066). The species *Z. dozei* differs from *Z. odiensis* first of all in its much wider umbilicus ($U = 34—39\%$ and $17—29\%$, respectively).

The subspecies *Z. dozei schroederi* Wiedmann (1962b, pp. 161—163, Text-figs 18—20, Pl. 8, Figs 12—13, and Pl. 13, Figs 3—4) shows whorls triangular in cross section, covered with fine but distinct, radial lirae which disappear at the subadult stages. In turn, the whorls are ovate in cross section in *Z. dozei dozei* (Fallot).

Occurrence. — Nos *101.2144—1, 106.7751—6, 184.6008—9a*: Lower Cenomanian, MGU Station, Band *IV-1* (Bed *1*), Crimea; No. *87.9106—1*: Lower Cenomanian, Mt. Kremennaya, Band *III* (uppermost part), Crimea (*cf.* Text-fig. 6).

The species *Zelandites dozei* (Fallot) has been recorded in the Albian to Cenomanian of Spain, France, Sardinia, Hungary, Algeria, Madagascar, and Japan.

Family Tetragonitidae Hyatt, 1900

Remarks. — The family Tetragonitidae Hyatt includes the genera *Tetragonites* Kossmat, *Carinites* Wiedmann, *Saghalinites* Wright & Matsumoto, and *Pseudophyllites* Kossmat, the first two of which occur also in the Cenomanian of Crimea and Dagestan Caucasus. The tetragonitids evolved during the Aptian from the Gaudryceratidae via *Eogaudryceras (Eotetragonites)*. They are conservative in shell ornamentation (usually the shell is smooth) but progressive in their hexalobate sutural line ($ELU_2U_3=SU_1I_s$).

Genus *TETRAGONITES* Kossmat, 1895
(Type species: *Ammonites timotheanus* Pictet, 1848)

Remarks. — The systematic position of the genus *Tetragonites* Kossmat, and especially of its Albian to Cenomanian representatives, is comprehensively discussed by Wiedmann (1962b, 1973) and Kennedy & Klinger (1977b). In the investigated collection the genus is represented by a few diagenetically deformed moulds with unpreserved sutural line, hence unidentifiable to the specific level, derived from the Cenomanian of Crimea and Dagestan Caucasus.

Occurrence. — The genus *Tetragonites* Kossmat shows a world-wide distribution, ranging from the Upper Aptian to Maastrichtian. According to Wiedmann (1973, p. 612), the Albian to Cenomanian species of the genus were spreading out from three evolutionary centers (West European Tethys, Madagascar, and North American Pacific Trough), and the climate could not be the main controlling factor in their distribution.

Tetragonites sp.
(Pl. 1, Figs 3—4)

Material: Two moulds, Nos *70.7754—9* (Pl. 1, Fig. 3) and *71.7754—9* (Pl. 1, Fig. 4).

Remarks. — Constructions are lacking in the specimen No. *70.7754—9* (Pl. 1. Fig. 3) which seems to show whorls ovate in cross section. These characteristics make that specimen close to the group of *Tetragonites jurinianus* (Pictet) (*cf.* Wiedmann 1973, p. 590).

The other specimen shows fine but distinct constrictions and whorls supposedly trapezoidal in cross section (Pl. 1, Fig. 4), which characteristics make it close to *Tetragonites subtimotheanus* Wiedmann (*cf.* Wiedmann 1973, pp. 590 and 592—595; Kennedy & Klinger 1977b, pp. 156—162).

Occurrence. — Middle Cenomanian, MGU Station, Band *IV-2* (Bed *3*), Crimea (*cf.* Text-fig. 6).

The investigated collection includes also three other specimens possibly attributable to the genus *Tetragonites* Kossmat, which cannot be even tentatively assigned to any species group because of their very poor preservation state. One of these specimens was collected in the Middle Cenomanian at Ajmaki, Dagestan Caucasus; the others in the Lower Cenomanian at the right border of Bodrak river at Trudolubovka, Crimea (*cf.* Text-fig. 5a).

Genus *CARINITES* Wiedmann, 1973
(Type species: *Tetragonites spathi* Fabre, 1940)

Remarks. — Wiedmann (1973, p. 609) erected this genus for tetragonitids "with subrectangular whorl cross section, numerous and irregularly spaced, but persistent constrictions and feeble ventral keel". However, Kennedy & Klinger (1977b, p. 152) noted a similar keel also in other tetragonitids and suggested that this is a raised siphonal area associated with the siphuncle; hence, they considered the name *Carinites* Wiedmann as a synonym of *Tetragonites* Kossmat.

The present author's collection includes tetragonitid specimens with a week keel in the middle of the ventral whorl side, while there is no such keel in similarly sized representatives of the genus *Tetragonites* derived from the same bed [MGU Station, Band IV-2 (Bed 3), Crimea]. This is why the genus *Carinites* Wiedmann is here accepted in spite of the reservations put forth by Kennedy & Klinger (1977b).

Occurrence. — The genus *Carinites* Wiedmann has thus far been reported from the Lower to Middle Cenomanian of southern France, and the Middle Cenomanian of Crimea and Dagestan Caucasus.

Carinites sp.

Material: Two specimens less than 24 mm in diameter, Nos *211.IV—2* and *118a.82a*.

Description. — The specimen No. *211.IV—2* shows whorls wide subrectangular in cross section, with rounded ventro-lateral shoulders, and a little convex venter with indistinct, obtuse keel in the middle. There is a single very feeble constriction at the whorl flank, considerably inclined forwards at the venter.

The other specimen shows no constrictions, and displays whorls subrectangular but more compressed in cross section, with more convex venter and better developed keel than in the former specimen. The absence of constrictions is suggestive of the specimen representing only inner whorls of a phragmocone (*cf.* Wiedmann 1973, p. 609).

Occurrence. — No. *211.IV—2*: Middle Cenomanian, MGU Station, Band *IV-2* (Bed *3*), Crimea (*cf.* Text-fig. 6); No. *118a.82a*: Middle Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

Suborder **Ancyloceratina** Wiedmann, 1966
Superfamily **Ancylocerataceae** Meek, 1876
Family **Ptychoceratidae** Meek, 1876
Genus *WORTHOCERAS* Adkins, 1928
(Type species: *Macroscaphites platydorsus* Scott, 1924)

Remarks. — The present author follows Wiedmann (1965) in assigning the genus *Worthoceras* Adkins to the family Ptychoceratidae Meek, instead of the Scaphitidae Meek as advocated by Wright (1957, 1979) and Henderson (1973).

Occurrence. — The genus *Worthoceras* Adkins has been recorded in the Upper Albian to Turonian of the United States (Texas and Kansas), the Turonian of France, the Cenomanian of England, Czechoslovakia, the Soviet Union (Crimea, Mangyshlak, Kopet-Dag), and Madagascar, and possibly the Upper Albian of New Zealand.

Worthoceras rochatianum (d'Orbigny, 1847)
(Pl. 2, Figs 1—4 and 7—9)

1872. *Scaphites Rochatianus*, Sow.; Fritsch, pp. 41—42, Pl. 13, Figs 1—2.
1911. *Scaphites Rochatianus*, D'Orb.; Frič, pp. 10—11, Fig. 34.

1929. *Macroscaphites Rochatianus* d'Orbigny; Collignon, pp. 57—58, Text-fig. 36, Pl. 7, Figs 8—10.
1965. *Worthoceras rochatianum* (d'Orbigny); Wiedmann, p. 439, Text-fig. 10d, Pl. 60, Figs 4—6.
non 1974. *Whorthoceras rochatianus* (d'Orbigny, 1847); Manija, pp. 154—155, Text-fig. 43, Pl. 11, Figs 3—4 [=*Worthoceras vermiculum* (Shumard)].

Material: Nine well- preserved, ferrugineous-siliceous moulds of fragments of the spiral portion and shaft or shaft and hook, and one complete specimen; Nos *II.W.9* (Pl. 2, Fig. 1), *II.W.1* (Pl. 2, Fig. 2), *II.W.2* (Pl. 2, Fig. 3), *II.W.3* (Pl. 2, Fig. 4), *II.W.7* (Pl. 2, Fig 7), *II.W.8* (Pl. 2, Fig. 8), *II.W.6* (Pl. 2, Fig. 9), *II.W.13*, and *II.W.14*.

Table 5

Specimen No.	D mm	Wb mm	d mm	wh %	wb %	u %	wb/wh
II.W.9	18.5	4.4	5.0	40.0	50.0	40.0	1.25
II.W.7		4.3					
II.W.8		4.5					
II.W.6		4.8					
II.W.2			4.4	31.8	43.2	38.6	1.36
II.W.3			5.1	41.2	49.0	31.4	1.19
II.W.1			5.3	39.6	45.3	35.8	1.14

Remarks. — In the investigated specimens the phragmocone includes not only the spiral portion but also a large part of the shaft (*cf.* Pl. 2, Figs 1—2, 7, and 9). The shaft is long, with flat dorsal side with an impression in the middle. The dorsal impression appears also, although indistinctly, at the beginning of the body chamber. In some specimens the whorl flank is covered with widely spaced (5—7 per whorl in the spiral portion), weakly developed ribs, sometimes in form of bullae (*cf.* Pl. 2, Fig. 4a). The specimens Nos *II.W.6* and *II.W.8* show a fragmentarily preserved, fine apertural collar at the body chamber, indiscernible in the photos.

The investigated specimens resemble very closely those from the Turonian of France (*cf.* Wiedmann 1965, Pl. 60, Figs 4—6).

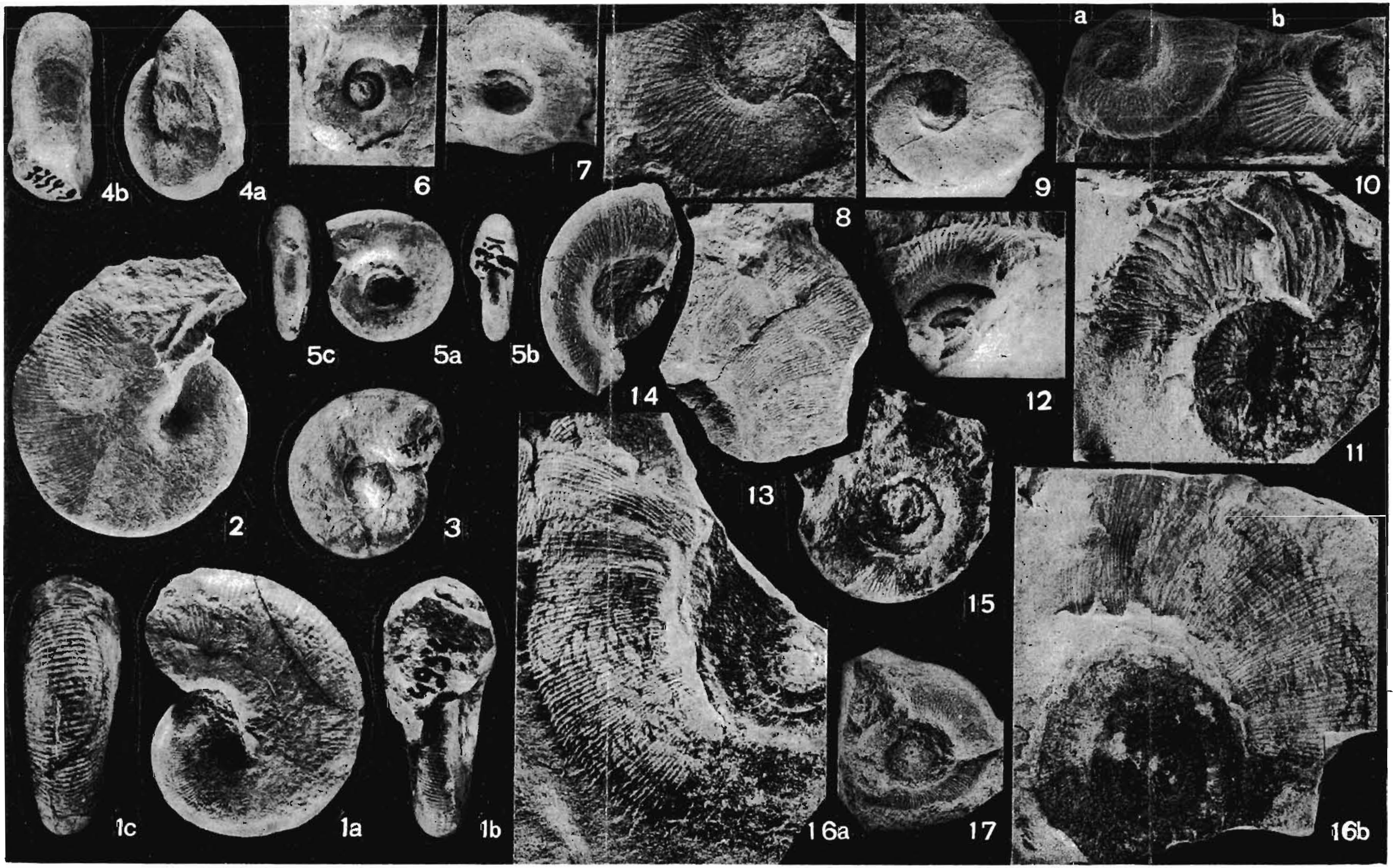
The species *Worthoceras rochatianum* (d'Orbigny) differs from its Albian relative *W. platydorsum* (Scott) in its more pronounced dorsal impression (Widemann 1965, pp. 439—440).

Occurrence. — Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *8* (upper part) and *9*, Mangyshlak (*cf.* Text-fig. 12).

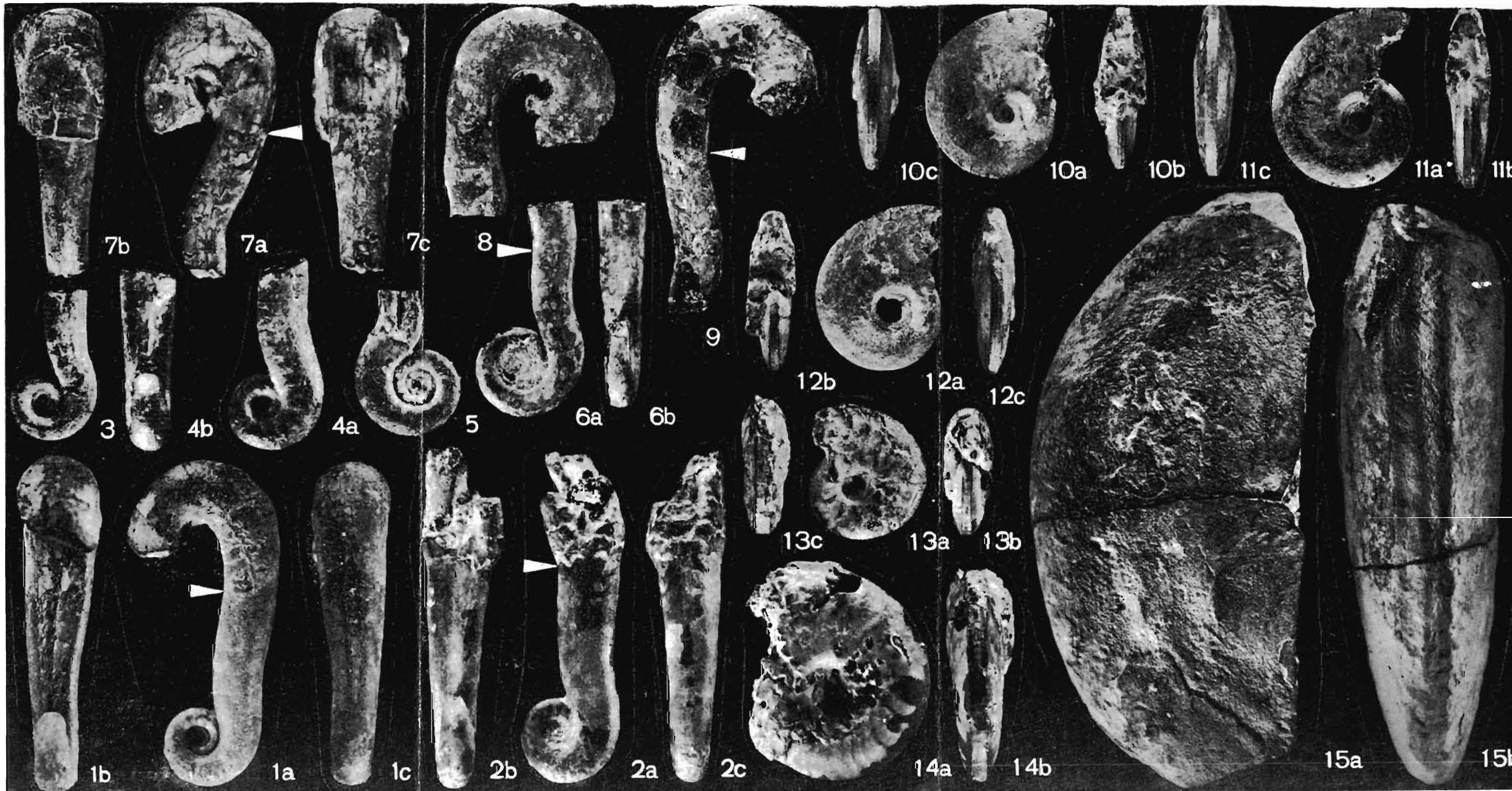
The species *Worthoceras rochatianum* (d'Orbigny) has been reported from the Cenomanian of Madagascar, the Upper Cenomanian of Czechoslovakia, and the Turonian of France.

Worthoceras vermiculum (Shumard, 1860)
(Pl. 2, Figs 5—6)

1942. *Worthoceras vermiculum* (Shumard); Moreman, pp. 214—215, Text-fig. 2p, Pl. 34, Figs 12—13.
1965. *Worthoceras vermiculum* (Shumard); Wiedmann, pp. 440—441, Text-fig. 10e—g, Pl. 59, Fig. 8, and Pl. 60, Figs 1—2.



Phylloceras (Hypophylloceras) seresitense seresitense Pervinquière: 1 — specimen No. 115.4954, Lower Cenomanian, MGU Station, Band IV-1 Bed 1, × 1.5. **Phylloceras (Hypophylloceras) cf. seresitense tanit** Pervinquière: 2 — specimen No. 93.7751-3, Lower Cenomanian, MGU Station, Band IV-1 Bed 1, × 1. **Tetragonites** sp.: 3 — specimen No. 70.7754-9, × 1; 4 — No. 71.7754-9, × 1.5; both from Middle Cenomanian, MGU Station, Band IV-2 Bed 3. **Zelandites dozei dozei** (Fallot): 5 — specimen No. 106.7751-6, × 2; 6 — No. 101.2144-1, × 1.6; 7 — No. 184.6008-9a, × 1.6; Lower Cenomanian, MGU Station, Band IV-1 Bed 1. **Mesogaudryceras leptonema** (Sharpe): 8 — specimen No. 96.536, Middle Cenomanian, Bielogorsk, × 1.3. **Mesogaudryceras rarecostatus** Balan: 9 — specimen No. 100.5071, Middle Cenomanian, Mender ravine, × 1.5. **Mesogaudryceras leptonema** (Sharpe); 10a — specimen No. 85.7758a, Middle Cenomanian, Mt. Selbukhra, lower part of Band V, × 1.5. **Mesogaudryceras rarecostatus** Balan: 10b — specimen No.85.7758b, Middle Cenomanian, Mt. Selbukhra, lower part of Band V, × 1.5; 11 — No. 94.491a-1, Middle Cenomanian, Bielogorsk, × 1.6; 12 — No. 99.9145, Middle Cenomanian, Mt. Selbukhra, lower part of Band V, × 1.5. **Anagaudryceras cf. cassisianum** (d'Orbigny): 13 — specimen No. 88.7754-6, Middle Cenomanian, MGU Station, Band IV-2 Bed 5, × 1. **Gaudryceras stefaninii** Venzo: 14 — specimen No. 113.12, × 2; 15 — No. 92.7009a, × 1.6; Middle Cenomanian, MGU Station, Band IV-3; 16 — No. 95.491a-2/3 (*16a* mould, *16b* cast), Middle Cenomanian, Bielogorsk, × 1.5; 17 — No. 179.6755, probably Middle Cenomanian, MGU Station, ?Band IV-2, × 1.6



Worthoceras rochatianum (d'Orbigny): **1** — specimen No. II.W.9, **2** — No. II.W.1, **3** — No. II.W.2, **4** — No. II.W.3, **7** — No. II.W.7, **8** — No. II.W.8, **9** — No. II.W.6; Middle Cenomanian, Sullu-kapy, upper part of Band 8 and Band 9 (*II* faunal horizon), × 4. **Worthoceras vermiculum** (Shumard): **5** — specimen No. II.W.5, **6** — No. II.W.4; Middle Cenomanian, Sullu-kapy, probably upper part of Band 8 and Band 9 (*II* faunal horizon), × 4. **Karamaites mediasiaticum** (Luppov): **10** — specimen No. II.P.3, **11** — No. II.P.1, **12** — No. II.P.2: Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon), × 2. **Karamaites grossouvrei** (Semenov): **13** — specimen No. II.P.20, **14** — No. II.P.10; Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon), × 2. **Pseudotissotia** sp.: **15** — specimen No. 158.7750, Middle Cenomanian, MGU Station, ?uppermost part of Band IV-2 or lower part of Band V, × 1
Arrow indicates the end of the phragmocone

1965. *Worthoceras vermiculum* (Shumard); Clark, p. 62, Pl. 4, Figs 9—11 [*cum syn.*].
1974. *Whorthoceras rochatianus* (d'Orbigny, 1847); Manija, pp. 154—155, Text-fig. 43, Pl. 11, Figs 3—4.
1975. *Worthoceras vermiculum* (Shumard); Hattin, p. 44, Pl. 5, Figs A, F, and K.
1977. *Worthoceras vermiculum* (Shumard); Hattin & Cobban, p. 185, Text-fig. 5 (?).
1978. *Worthoceras vermiculum* (Shumard); Hattin & Siemers, p. 29, Text-fig. 6 (?).

Material: Two ferrugineous-siliceous moulds of the spiral portion and a fragment of the shaft, Nos *II.W.5* (Pl. 2, Fig. 5), *II.W.4* (Pl. 2, Fig. 6).

Table 6

Specimen No.	d mm	wh %	wb %	u %	wb/wh
II.W.5	5.7	35.1	38.6	47.4	1.10
II.W.4	6.1	29.5	32.8	52.4	1.11

Remarks. — The investigated specimens show a wide umbilicus, small whorl breadth in the spiral portion, relatively short shaft, and very weakly developed dorsal impression, which characteristics differ them from *Worthoceras rochatianum* (d'Orbigny). The sutural line exhibits the same elements as in the Lower Turonian specimens from Texas, and the ventral, lateral, and dorsal saddles and lobes are as subdivided as in the hypotypoid (*cf.* Wiedmann 1965, Text-fig. 10f). The investigated specimens are smaller-sized than those from Texas but their umbilicus is much wider (*U*=47—52 and 34—42, respectively).

Discussion. — The specimens attributed by Manija (1974, Pl. 11, Figs 3—4) to *Worthoceras rochatianum* (d'Orbigny) show relatively wide umbilicus and short shaft, which makes them close to *W. vermiculum* (Shumard) rather than to the former species.

Occurrence. — Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Band *9* and probably the upper part of Band *8*, Mangyshlak (*cf.* Text-fig. 12).

The species *Worthoceras vermiculum* (Shumard) has been recorded in the Upper Cenomanian of Kopet-Dag in the Soviet Union (Protacanthoceras kopetdagensis Zone in the local stratigraphic subdivision), and the lowermost Turonian of the United States (Texas and Kansas).

Worthoceras sp.

Material: Five moulds of the hook or fragments of the shaft and hook, Nos *4a.7755—10/1, 4b.7755—10/2, II.W.10, II.W.11, and II.W.12.*

Remarks. — The specimen No. *4a.7755—10/1* shows a relatively long and smooth shaft, ended with tightly coiled hook, partly covered with fine but distinct ribs. The ribs are most conspicuous at the venter, less distinct at the flank, while they seem to fuse two ribs into a single one below the whorl mid-height. The adapertural part of the hook is smooth, whereas the aperture is collared and provided with very long lateral lappets.

The other specimens are very fragmentarily preserved. One may only note that the hook of the specimen No. *4b.7755—10/2* also shows an apertural collar.

Occurrence. — Nos *4a.7755—10/1, 4b.7755—10/2*: Middle Cenomanian, MGU Station, Band *IV-2*, Crimea (*cf.* Text-fig. 6); Nos *II.W.10, II.W.11, II.W.12*: Middle

Cenomanian, Sullu-kapy, *II* faunal horizon, Band *9* and probably the upper part of Band *8*, Mangyshlak (*cf.* Text-fig. 12).

Family Hamitidae Hyatt, 1900
Genus *HAMITES* Parkinson, 1811
(Type species: *Hamites attenuatus* J. Sowerby, 1814)

Remarks. — The genus *Hamites* Parkinson is here meant wider than by Wright (1957, p. L216) because it includes also, at the subgeneric level, *Stomohamites* Breistroffer and *Plesiohamites* Breistroffer (*cf.* also Marcinowski & Naidin 1976, pp. 98—99). The investigated hamitid collection includes representatives of the subgenus *Stomohamites* only.

Occurrence. — The genus *Hamites* Parkinson shows a world-wide distribution, ranging from the Upper Aptian to Lower Turonian.

Subgenus *STOMOHAMITES* Breistroffer, 1940
(Type species: *Hamites virgulatus* Brongniart, 1822)
Hamites (Stomohamites) duplicatus Pictet & Campiche, 1861
(Pl. 3, Figs 1—2)

1861. *H. duplicatus*, Pictet et Campiche; Pictet & Campiche, p. 98.
1941. *Hamites (Stomohamites) duplicatus*, Pictet and Campiche; Spath, pp. 640—642, Text-fig. 232, Pl. 72, Figs 12—16 [*cum syn.*].
1947. *Stomohamites duplicatus* Pict. et C. sp.; Breistroffer, p. 63.
1968. *Hamites (Stomohamites) duplicatus* Pictet et Campiche; Renz, p. 68, Text-fig. 23h—k, Pl. 11, Figs 19—21.
1971. *Stomohamites duplicatus* (Pictet and Campiche); Kennedy, p. 6, Pl. 5, Fig. 12.
1977. *Hamites (Stomohamites)* cf. *parkinsoni* (Fleming, 1828); Kotetishvili, p. 44, Pl. 8, Fig. 10.
1979. *Hamites duplicatus* Pictet & Campiche, 1861; Cooper & Kennedy, pp. 227—228, Figs 16D and 32A.

Material: Phosphatic and ferrugineous moulds of whorl fragments, Nos *A.H.M.3* (Pl. 3, Fig. 1), *II. St. 9* (Pl. 3, Fig. 2), *A.H.M.4*, *I.St.38a*, *I.St.38b* and *I.St.40*.

Remarks. — The specimen No. *A.H.M.3* (Pl. 3, Fig. 1) is preserved with a part of the aperture. It shows the lower collar and constriction, 8—9 ribs at a whorl fragment equal in length to the costal whorl height, and subcircular whorl cross section (Wb: Wh=0.90); it resembles very closely one of the specimens illustrated by Spath (1941, Text-fig. 232j—l). The specimen No. *A.H.M.4*, which also is a fragment of body chamber, is less densely ribbed (6—7 ribs at a whorl fragment equal in length to the costal whorl height) which makes it close to the forms discussed by Renz (1968, p. 68, Pl. 11, Figs 19—21). The remaining specimens, Nos *II.St.9* (Pl. 3, Fig. 2), *I.St.38a*, *I.St.38b*, and *I.St.40*, present a more or less curved phragmocone fragment, with less conspicuous but more densely spaced ribs and more ovate whorl cross section, which makes them similar to *Hamites (Stomohamites) lineatus* Spath. Their ribs do not bifurcate into fine secondaries at the dorsum, just as it is the case also with the forms discussed by Renz (1968). The specimen illustrated by Kotetishvili (1977, Pl. 8, Fig. 10) under the name of *Hamites (S)* cf. *parkinsoni* (Fleming) shows rather fine and densely spaced ribs, like in one of the specimens figured in the present paper (Pl. 3, Fig. 2), which makes it close to Hamites *(S.) duplicatus* rather than to *Hamites (S.) parkinsoni.*

Occurrence. — Nos *A.H.M.3*, *A.H.M.4:* Lower to mid-Middle Cenomanian in the condensed sequence at Annopol, Holy Cross Mts, Poland (*cf.* Text-fig. 3); Nos *I.St.38a*, *I.St.38b*, *I.St.40*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); No. *II.St.9*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *8* (upper part) and *9*, Mangyshlak (*cf.* Text-fig. 12).

The species *Hamites (Stomohamites) duplicatus* Pictet & Campiche has been recorded in the upper Upper Albian to Lower Cenomanian of France, Switzerland, England, the Soviet Union (Georgia and Kopet-Dag), and Africa (Angola and Madagascar).

Hamites (Stomohamites) simplex d'Orbigny, 1842

1840—1842. *Hamites simplex*, d'Orbigny; d'Orbigny, pp. 550—551, Pl. 134, Figs 12—15.
non 1959. *Hamites simplex* d'Orbigny; Cieśliński, p. 35, Pl. 3, Fig. 7.
1971. *Stomohamites simplex* (d'Orbigny); Kennedy, pp. 6—7, Pl. 1, Figs 1—8.
1972. *Stomohamites* cf. *S. simplex* (d'Orbigny); Cobban & Scott, p. 44, Pl. 13, Figs 5—10, Pl. 17, Figs 3—4.
1976. *Stomohamites simplex* (d'Orbigny); Juignet & Kennedy, p. 51, Pl. 1, Figs 8—10.
1976. *Stomohamites simplex* (d'Orbigny); Kennedy & Hancock, p. 38, Pl. 9, Figs 8 and 10—14.

Material: Calcareous mould, No. *43.5533/1.*

Remarks. — The investigated specimen resembles most closely that one illustrated by Kennedy (1971, Pl. 1, Fig. 7). The present author agrees with Kennedy (1971, p. 7) that the specimen figured by Cieśliński (1959, Pl. 3, Fig. 7) under the name of *Hamites simplex* d'Orbigny, "has distinctly oblique ribbing, suggesting that it belongs to another species."

Occurrence. — Middle Cenomanian (along with *Acanthoceras rhotomagense* cf. *subflexuosum* Spath), Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

The species *Hamites (Stomohamites) simplex* d'Orbigny has been reported from the Cenomanian (mostly the Middle Cenomanian) of England, France, the Soviet Union (Kopet-Dag), Western Interior of the United States, and Australia.

Hamites (Stomohamites) sp.

Material: Ferrugineous moulds of small fragments of curved phragmocones, Nos *I.St.37a* and *I.St.37b*.

Description. — The specimen No. *I.St.37a* shows an ovate whorl cross section (*Wb*: *Wh*=0.80) and singular ribs, 6 in number at a whorl fragment equal in length to the costal whorl height. The ribs are most conspicuous at the narrow and rounded venter, less prominent at the whorl flank, and indistinct at the dorsum.

The other specimen, No. *I.St.37b*, shows a more circular whorl cross section (*Wb*: *Wh*=0.92) and singular ribs, 5 in number at a whorl fragment equal in length to the costal whorl height. The ribs are most conspicuous at the venter, less prominent at the whorl flank, and hardly discernible at the dorsum. The specimen resembles *Hamites (Stomohamites) parkinsoni* (Fleming).

Occurrence. — Lower Cenomanian, Sullu-kapy, I faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

Genus *HEMIPTYCHOCERAS* Spath, 1925
(Type species: *Ptychoceras gaultinum* Pictet, 1847)

Diagnosis and discussion: See Wright (1957, pp. *L216*—*L217*), Wiedmann & Dieni (1968, p. 61), and Cobban & Scott (1972, p. 44).

Occurrence. — The genus *Hemiptychoceras* occurs in the Upper Albian to Cenomanian of Spain, France, Switzerland, Sardinia, Rumania, Hungary, the Soviet Union (Crimea), Madagascar, southern India, and possibly the United States (Colorado and Kansas).

Hemiptychoceras gaultinum subgaultinum Breistroffer, 1940
(Pl. 3, Figs 3—4)

1907. *Hamites (Ptychoceras) gaultinus* Pictet et Roux; Boule, Lemoine & Thevenin, p. 56, Pl. 13, Fig. 1.

1979. *Hemiptychoceras gaultinum subgaultinum* Breistroffer, 1940; Scholz, pp. 20—21, Pl. 1, Fig. 18 [*cum syn.*].

Material: Diagenetically laterally compressed, marly moulds, Nos *10.31* (Pl. 3, Fig. 3), *9a.8149—1/1* (Pl. 3, Fig. 4), and *9b.8149—1/2*.

Remarks. — The investigated specimens consist each of parts of two final shafts (the second and third ones), pressed closely together, and the connecting elbow. There are constrictions at the second shaft, with the last constriction separating the phragmocone from the body chamber. Both the second shaft and the elbow of the body chamber are finely and densely ribbed (12 ribs at a whorl fragment equal in length to the costal whorl height), whereas the ribs rapidly become more conspicuous and twice less numerous (6 in number at a whorl fragment equal in length to the costal whorl height; *cf.* also Pl. 3, Fig. 4) at the third shaft. Because of this ornamentation, the specimens under discussion resemble very closely the lectotype illustrated by Boule & *al.* (1907, Pl. 13, Fig. 1).

Discussion. — The present author agrees with Scholz (1979, p. 20) that the forms *tropicum* Kossmat, 1895, and *subgaultinum* Breistroffer, 1940, are to be recognized for subspecies of *Hemiptychoceras gaultinum* (Pictet) rather than for distinct species.

The uppermost Cenomanian to Lower Turonian species *Hemiptychoceras reesidei* Cobban & Scott differs from *H. gaultinum* in its much smaller-sized shell and the absence of a conspicuous constriction separating the second shaft from the elbow of the body chamber. These characteristics indicate that this is a form transitional to the genus *Metaptychoceras* Spath, or even representative of the latter taxon.

Occurrence. — Probably Lower Cenomanian, Mt. Kremennaya, supposedly Bands *II—III*, Crimea (*cf.* Text-fig. 6).

The subspecies *Hemiptychoceras gaultinum subgaultinum* Breistroffer has been recorded in the Upper Albian of northern Spain, Sardinia, France, and Hungary, and the Cenomanian of Madagascar.

Family **Baculitidae** Meek, 1876
Genus *SCIPONOCERAS* Hyatt, 1894
(Type species: *Hamites baculoides* Mantell, 1822)

Diagnosis: See Wright (1957, p. L218) and Matsumoto (1959a, p. 103).

Occurrence. — The genus *Sciponoceras* Hyatt shows a world-wide distribution, ranging from the uppermost Albian to Upper Turonian.

Sciponoceras baculoide (Mantell, 1822)
(Pl. 3, Figs 17—20)

1822. *Hamites baculoides*; Mantell, p. 123, Pl. 23, Figs 6—7.
1885. *Baculites baculoides* Mantell; Noetling, p. 42, Pl. 8, Fig. 7.
1959a. *Sciponoceras baculoide* (Mantell); Matsumoto, pp. 104—106, Text-fig. 2, Pl. 31, Fig. 1 [*cum syn.*].
1959. *Sciponoceras subbaculoides* (Geinitz); Cieśliński, pp. 38—39, Text-fig. 14 (I), Pl. 4, Fig. 5.
1963. *Sciponoceras baculoides* (Mantell); Matsumoto & Obata, pp. 9—12, Text-figs 3 and 26—32, Pl. 1, Figs 1—4, Pl. 2, Figs 1—3.
1970. *Sciponoceras subbaculoides* (Geinitz, 1874); Marcinowski, pp. 429—430, Pl. 2, Fig. 7.
1971. *Sciponoceras baculoide* (Mantell); Kennedy, pp. 9—10, Pl. 1, Figs 12—18, Pl. 2, Figs 1—5, Pl. 3, Figs 1—2, 8, 11, and Pl. 4, Fig. 14.
1974. *Sciponoceras subbaculoides* (Geinitz); Marcinowski, Pl. 31, Fig. 1.
1976. *Sciponoceras baculoide* (Mantell); Juignet & Kennedy, pp. 52—53, Pl. 1, Figs 3—6, Pl. 2, Figs 1—3.

1979. *Sciponoceras baculoide* (Mantell); Wiedmann & Schneider, pp. 656—657, Text-fig. 5 and Pl. 4, Figs 2—4.

Material: Calcareous and ferrugineous moulds presenting, in part, body chambers preserved along with aperture; Nos *16.7755—9/3* (Pl. 3, Fig. 17), *14.7755—9/1* (Pl. 3, Fig. 18), *15.7755—9/2* (Pl. 3, Fig. 19), *18.7755—9/5* (Pl. 3, Fig. 20), *17.7755—9/4*, *19a.7755—9*, *21.4*, *23a.86a/16*, *23b.86a/16*, *23d.86a/16*, *I.Sci.32a*, *I.Sci.32b*, *I.Sci.33a*, *I.Sci.33b*, *I.Sci.34a*, *I.Sci.34b*, *I.Sci.35*, *II.Sci.1*, *II.Sci.9*, *II.Sci.1051/1*, *II.Sci.1051/2*, *II.Sci.1051/3*, and 28 specimens labelled with the symbol *19.7755—9*, and 60 specimens labelled with the symbol *I.Sci.*

Remarks. — The investigated collection includes mostly phragmocone fragments supplemented with some specimens of body chamber preserved along with the aperture. It is notable that coarsely ribbed body chambers are associated, often in a single bed [Band *IV-2* (Bed 4) at MGU Station], with less frequent finely ribbed ones, just as it is the case in Dorset (*cf.* Kennedy 1971, p. 10). Representatives of the genus *Sciponoceras* Hyatt preserved with complete body chamber along with the aperture are among rarities (Matsumoto 1959a, pp. 103—104; Kennedy 1971, p. 9) and hence, only those specimens preserved with these shell parts (*cf.* Pl. 3, Figs 17—20) will be discussed below.

The considered body chambers (Pl. 3, Figs 17—20) show ribs, and sometimes also fine striae (Pl. 3, Fig. 19), at the outer side and venter. The ribs are most conspicuous at the venter, while they disappear at the mid-flank. At the venter they have a gentle adapical and a steep adoral slope, which results in their characteristic asymmetric profile. The adapertural part always shows 4 coarse ventral ribs at a whorl fragment equal in length to the median diameter (=mean of the maximum and minimum diameters of diagenetically deformed body chambers). This ribbing resembles closely that in the specimens illustrated by Kennedy (1971, Pl. 2, Figs 1—3, and Pl. 4, Fig. 14).

Two aperture forms occur in the considered body chambers. The more frequent one (Pl. 3, Figs 17—19) is associated with a pair of well-developed, dorsally curved latero-ventral lappets; the apertural constriction is most pronounced at the venter, while a very slight sinus covers the remainder of the apertural margin. This aperture form is exactly like that in the specimen figured by Noetling (1885, Pl. 8, Fig. 7). The other aperture form (Pl. 3, Fig. 20) is oblique, with simple apertural margin, more or less parallel to the last rib; the apertural margin shows a very slight sinus and is only a little facing on the dorsum. This aperture resembles that one presented by Matsumoto (1959a, Pl. 31, Fig. 1). There is no dorsal rostrum in the investigated specimens.

Discussion. — The four above described body chambers were collected from the same bed [Band *IV-2* (Bed 4) at MGU Station]. They resemble each other in size and ribbing, while their variation consists exclusively in aperture form. The present author is of the opinion that this is a case of sexual dimorphism. Consequently, the specimens Nos *14.7755—9/1*, *15.7755—9/2*, *16.7755—9/3*, and *19a.7755—9* (*cf.* also Pl. 3, Figs 17—19) are to be recognized for males (microconchs), and the specimen No. *18.7755—9/5* (Pl. 3, Fig. 20) for a female (macroconch), because no macroconchs with lappets have thus far been discovered (*cf.* Makowski 1962a, b). One deals here with a special case of ammonoid sexual dimorphism, the micro- and macroconchs being indistinguishable in shell size and ornamentation but different in aperture form.

The investigated apertures differ from all thus far known apertures of the species *Sciponoceras baculoide* (Mantell) in the absence of dorsal rostrum, as well as in the well-developed latero-ventral lappets of the microconchs (*cf.* Matsumoto 1959a, Pl. 31, Fig. 1; Matsumoto & Obata 1963, Pl. 2, Figs 1 and 3; Kennedy 1971, Pl. 2, Fig. 3; Juignet & Kennedy 1976, Pl. 1, Figs 3—4, 6, and Pl. 2, Fig. 1). When the opinion of Wright (*in* Matsumoto 1959a, p. 103), who stated that "the character of the aperture seems to be important for the specific distinction" in the genus *Sciponoceras*, is taken into account, this difference in aperture form may indicate that the investigated specimens are to be recognized for a distinct subspecies.

Kennedy (1971, p. 10) noted that *Sciponoceras subbaculoides* (Geinitz) is a *nomen dubium*, and the specimen illustrated by Geinitz (1875, Pl. 63, Fig. 1) probably belongs to *S. gracile* (Shumard). The present author agrees with Kennedy's opinion and transfers the Polish Cenomanian specimens of *S. subbaculoides* (cf. Cieśliński 1959; Marcinowski 1970, 1974) to the species *S. baculoide*.

Occurrence. — Nos *I.Sci.32a*, *I.Sci.32b*, *I.Sci.33a*, *I.Sci.33b*, *I.Sci.34a*, *I.Sci.34b*, *I.Sci.35*, and 60 other specimens labelled with the symbol *I.Sci.*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); Nos *23a.86a/16*, *23b.86a/16*, *23d.86a/16*: Middle Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9); Nos *14.7755—9/1*, *15.7755—9/2*, *16.7755—9/3*, *17.7755—9/4*, *18.7755—9/5*, *19a.7755—9*, and 28 other specimens labelled with the symbol 19.7755—9: Middle Cenomanian, MGU Station, Band *IV-2* (Bed *4*), Crimea (*cf.* Text-fig. 6); No. *21.4*: Middle Cenomanian, Band *IV-2* (Bed *5*), southwestern Crimea Highland; Nos *II.Sci.1*, *II.Sci.9*, *II.Sci.1051/1*, *II.Sci.1051/2*, *II.Sci.1051/3*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *7—9*, Mangyshlak (*cf.* Text-fig. 12).

The species *Sciponoceras baculoide* (Mantell) shows a world-wide distribution, having been recorded in the entire Cenomanian.

Sciponoceras roto Cieśliński, 1959
(Pl. 3, Figs 14—15)

1959. *Sciponoceras roto* n. sp.; Cieśliński, pp. 39—40 and 89, Text-fig. 14 (III), Pl. 4, Fig. 10.
1971. *Sciponoceras roto* Cieśliński; Kennedy, pp. 10—11, Pl. 3, Fig. 7.
1975. *Sciponoceras roto* Cieśliński; Kennedy & Klinger, p. 277.

Material: One ferrugineous and one phosphatic mould, Nos *II.Sci.2* (Pl. 3, Fig. 14) and *A.R.M.4* (Pl. 3, Fig. 15), respectively.

Remarks. — The investigated specimens show whorls subcircular in cross section (*Wb*: *Wh*=0.94—0.95), non-ornamented, with very widely spaced constrictions (there is only one constriction at a whorl fragment equal in length to 2.8 shell diameters in the specimen No. *II.Sci.2*), which characteristics are diagnostic of the species *Sciponoceras roto* Cieśliński (*cf.* Cieśliński 1959, pp. 40 and 89).

Occurrence. — No. *II.Sci.2*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *7—8*, Mangyshlak (*cf.* Text-fig. 12); No. *A.R.M.4*: Upper Cenomanian at Annopol, a few centimeters above the hardground, Holy Cross Mts, Poland (*cf.* Text-fig. 3).

The species *Sciponoceras roto* Cieśliński has been reported from the Lower Cenomanian of southern England and southern Africa, and the entire Cenomanian of Poland.

Sciponoceras sp.
(Pl. 3, Fig. 16)

Material: Calcareous mould of a fragment of body chamber preserved with complete aperture, No. *23e.86a/16*.

Description. — The whorl is almost circular in cross section (*Wb*: *Wh*=0.96), covered with fine ribs starting much above the mid-flank. The ribs incline adorally and pass straight across the venter where they attain their maximum conspicuousness. In the adapertural part of the specimen there are 9 ventral ribs at a fragment equal in length to the whorl height (20.9 mm). The ribs seem to decline adapically (*cf.* Pl. 3, Fig. 16a), which suggests that the ribbing is confined to the adapertural part of body chamber. The aperture bears two well-developed, long and narrow, curved dorsally latero-ventral lappets (Pl. 3, Fig. 16). It is constricted at the venter, with a very slight sinus all over the remainder of the apertural margin. The apertural margin is slightly facing dorsally, but there is no dorsal rostrum.

Remarks. — The investigated specimen differs from *S. baculoide* (Mantell) in its much more pronounced latero-ventral lappets, circular whorl cross section, and finer and twice more densely spaced ribs. Its fine and dense ribbing confined to the adapertural part of body chamber makes a resemblance to *S. baculoide* as illustrated by Matsumoto & Obata (1963, Pl. 2, Figs 1 and 3), which shows aperture similar to that recorded in *S. roto* Cieśliński (*cf.* Cooper & Kennedy 1977, p. 653). However, the investigated specimen is much larger-sized than the latter ones and differs also in the occurrence of its pronounced, curved dorsally latero-ventral lappets.

Occurrence. — Middle Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

Family Anisoceratidae Hyatt, 1900
Genus *ANISOCERAS* Pictet, 1854
(Type species: *Hamites saussureanus* Pictet, 1847; by the original designation of Pictet, 1854)

Diagnosis: See Spath (1939, p. 542).

Occurrence. — The genus *Anisoceras* Pictet shows a world-wide distribution, ranging from the Upper Albian to Cenomanian.

Anisoceras plicatile (J. Sowerby, 1819)
(Pl. 3, Figs 5—8)

1971. *Anisoceras plicatile* (J. Sowerby); Kennedy, pp. 12—13, Pl. 3, Figs 12—13, Pl. 4, Figs 1—3 [*cum syn.*].
1971. *Anisoceras armatum* (J. Sowerby); Kennedy, p. 14, Pl. 5, Fig. 11.
1971. *Anisoceras plicatile* (J. Sowerby); Cobban, pp. 4—5, Text-fig. 2, Pl. 1, Figs 4—7.
1972. *Anisoceras* cf. *A. plicatile* (J. Sowerby); Cobban & Scott, p. 49, Text-fig. 19.
1976. *Anisoceras plicatile* (J. Sowerby); Juignet & Kennedy, pp. 55—56, Pl. 2, Figs 8—10.

Material: One ferrugineous and eight marly and calcareous moulds of whorl fragments, Nos *II.An.1* (Pl. 3, Fig. 5), *20.7754—2* (Pl. 3, Fig. 6), *25.82a/1* (Pl. 3, Fig. 7), *33.6024a/1* (Pl. 3, Fig. 8), *23c.36a/16*, *25.82a/2*, *22.7753—9*, *34.6024a/2*, and *44.5522/2*.

Remarks. — The investigated specimens show two ventral and two lateral, prominent, rounded tubercles at a principal rib at all ontogenetic stages. Three conspicuous ventral ribs, equal to each other, are fused at each ventral tubercle and continue as far as the lateral tubercle; in turn, there are only two ribs dorsally of each lateral tubercle (Pl. 3, Figs 6—8). At the inner whorls two non--tuberculate intermediate ribs occur between each two tuberculate, principal ones (Pl. 3, Fig. 6), just as it is the case with the specimens illustrated by Spath (1939, Text-fig. 196f—g) and Kennedy (1971, Pl. 3, Fig. 13, and Pl. 4, Figs 2—3). The principal ribs and tubercles considerably increase in conspicuousness in ontogeny; furthermore, the principal ribs tend to fuse one with another at the venter, while non-tuberculate intermediate ribs occur only sporadically (Pl. 3, Figs 7—8). This ornamentation makes the investigated specimens very similar to that one figured by Kennedy (1971, Pl. 3, Fig. 12).

Cooper & Kennedy (1979, p. 202) stated that the specimen illustrated by Kennedy (1971, Pl. 5, Fig. 11) under the name of *Anisoceras armatum* (J. Sowerby) belongs to another species. That specimen displays prominent ventral tubercles where 3—4 principal ribs are fused, with one non-tuberculate intermediate rib between each two tubercles. Thus, it resembles in ornamentation the specimen No. *25.82a/1* (Pl. 3. Fig. 7) and most probably is attributable to *A. plicatile* (J. Sowerby).

When compared to the Upper Albian species *A. pseudoelegans* Pictet & Campiche, the species *A. plicatile* (J. Sowerby) not only exhibits, "a more hexagonal whorl-section and more prominent, rounded tubercles, in addition to conspicuous ribbing across the dorsal area, but (also) it remains a torticone to a much larger diameter" (Spath 1939, p. 557).

Occurrence. — No. *32.7753—9*: uppermost Lower Cenomanian, Band *IV-1* (Bed *2*), MGU Station, Crimea (*cf.* Text-fig. 6); Nos *20.7754—2, 33.6024a/1, 34.6024a/2*: lower Middle Cenomanian, Band *IV-2* (Beds *3—4*), MGU Station and southern slope of the Mt. Selbukhra, Crimea (*cf.* Text-fig. 6); Nos *23c.86a/16, 25.82a/1, 25.82a/2, 32.7753—9, 44.5522/2*: Middle Cenomanian (except for the first of these specimens, along with *Acanthoceras rhotomagense* cf. *subflexuosum* Spath), Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9); No. *II.An.1*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *7—9*, Mangyshlak (*cf.* Text-fig. 12).

The species *Anisoceras plicatile* (J. Sowerby) has been recorded in the Cenomanian of Europe, Asia (Mangyshlak, Kopet-Dag), Madagascar, and Western Interior of the United States.

Anisoceras auberti (Pervinquière, 1907)
(Pl. 3, Fig. 9)

1907. *Hamites (Anisoceras?) Auberti* Pervinquière 1907; Pervinquière, p. 85, Pl. 3, Fig. 32.
1971. *Anisoceras auberti* (Pervinquière); Kennedy, pp. 11—12, Pl. 3, Figs 3—4 and 9 [*cum syn.*].
?1971. *Anisoceras aff. auberti* (Pervinquière); Kennedy, Pl. 3, Fig. 5.
1976. *Anisoceras auberti* (Pervinquière); Kennedy & Hancock, p. 37, Pl. 4, Fig. 3.

Material: Phosphatic mould of a fragment of phragmocone and body chamber, No. *A.H.M.9*.

Remarks. — The whorl is ovate in cross section (*Wb*: *Wh*=0.79), with 11 ribs at a whorl fragment equal in length to the costal whorl height. The ribs are fine but sharp, most commonly coupled by fine tubercles at the ventro-lateral shoulder, forming a characteristic loop at the venter (Pl. 3, Fig. 9*a*—*b*). Sporadically, a singular tuberculate rib occurs, associated with a non-tuberculate one. The ribs decline dorsally (Pl. 3, Fig. 9*c*).

The investigated specimen is almost indistinguishable in ornamentation from the lower part of the right shaft of the final hook of the holotype (*cf.* Pervinquière 1907, Pl. 3, Fig. 32). It is however to be noted that the ornamentation undergoes a simplification in ontogeny in Pervinquière's specimen, as its ribs become more prominent and predominantly singular, just as it is the case with some Albian species of the genus *Anisoceras*. The investigated specimen resembles rather closely the Lower Cenomanian forms from England, but it less frequently shows non-tuberculate ribs among the principal, tuberculate ones (*cf.* Kennedy, 1971, p. 12).

The species *Anisoceras auberti* (Pervinquière) differs from the above discussed *A. plicatile* (J. Sowerby) in the absence of lateral tubercles, finer ornamentation, more ovate whorl cross section, and arched venter.

Occurrence. — Lower to mid-Middle Cenomanian condensed sequence at Annopol, Holy Cross Mts, Poland (*cf.* Text-fig. 3).

The species *Anisoceras auberti* (Pervinquière) has been reported from the Cenomanian of Tunisia, and the Lower Cenomanian of southern England.

Anisoceras aff. *exoticum* Spath, 1939

Material: Ferrugineous, diagenetically flattened mould, No. *I.An.35*.

Remarks. — The occurrence of 3—8 intermediate non-tuberculate ribs between each two principal, tuberculate ribs (each one with two ventral tubercles), and the apparent decline of the ribs in the dorsal area make up the characteristics of the species *exoticum* Spath. However, the investigated specimen differs from those discussed by Spath (1939, Text-fig. 195, Pl. 59, Fig. 7, Pl. 60, Fig. 4, Pl. 63, Fig. 2) and Renz (1968, Pl. 16, Fig. 4) in each of its principal ribs bearing a well-developed ventral tubercle only at one ventro-lateral shoulder, while showing only a slight swelling at the other shoulder. This disturbance in ornamentation may be caused by some pathologic factors.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf*. Text-fig. 12).

Genus *IDIOHAMITES* Spath, 1925
(Type species: *Hamites tuberculatus* J. Sowerby, 1818)

Diagnosis and discussion: See Kennedy (1971, p. 14) and Cooper & Kennedy (1979, p. 222).

Occurrence. — The genus *Idiohamites* Spath has been recorded in the Upper Albian to Middle Cenomanian of Europe, northern and southern Africa and Madagascar, and the United States (Texas).

Idiohamites alternatus vectensis Spath, 1939
(Pl. 3, Figs 10—11)

1939. *Idiohamites alternatus* var. *vectensis* nov.; Spath, p. 598.
1971. *Idiohamites alternatus vectensis* Spath; Kennedy, pp. 18—19, Pl. 4, Figs 5, 7—8, 10—11, and Pl. 5, Figs 1—3, 5, 8—9 [*cum syn.*].

Material: Phosphatic moulds of whorl fragments, Nos *A.H.M.7* (Pl. 3, Fig. 10), *A.H.M.5* (Pl. 3, Fig. 11), *A.H.M.8*, and *A.R.M.3*.

Remarks. — The investigated specimens (Pl. 3, Figs 10—11) display 4, alternately tuberculate and non-tuberculate, ribs at a whorl fragment equal in length to the whorl height, and are consistent with diagnosis of the subspecies *vectensis* Spath (*cf*. Kennedy 1971, p. 18). According to Kennedy (1971, p. 18), *Idiohamites* sp. *B* of Cieśliński (1959, pp. 37 and 88—89, Pl. 4, Fig. 6) who recognized it for a degenerated variety of *I. alternatus* (Mantell) is to be attributed to the subspecies *vectensis* Spath, and this opinion is accepted also by the present author. Differences among the Cenomanian representatives of the genus *Idiohamites* are discussed in more detail by Kennedy (1971, pp. 14—18) who noted that the subspecific differences "are probably of little real value".

Occurrence. — Lower to mid-Middle Cenomanian condensed sequence at Annopol, Holy Cross Mts, Poland (*cf*. Text-fig. 3).

The subspecies *Idiohamites alternatus vectensis* Spath has been recorded in the Lower Cenomanian of France, England, Poland, and Algeria.

Idiohamites aff. *ellipticus radiatus* Spath, 1939
(Pl. 3, Fig. 12)

Material: Phosphatic whorl fragment, No. *A.H.M.6*.

Description. — The ribs are prominent and rectiradiate at the whorl flank, but they disappear in the dorsal area. There are two ventral tubercles at each rib, somewhat smaller at every second rib (this difference in size is hardly discernible). There are 4 ribs at a whorl fragment equal in length to the whorl height.

Remarks. — The occurrence of relatively prominent, straight ribs, each one with two ventral tubercles, makes the investigated specimen close to *Idiohamites ellipticus radiatus* Spath (*cf.* Kennedy 1971, Pl. 4, Fig. 6). On the other hand, the spacing of ribs and the weakened ornamentation at every second rib make an affinity to *I. alternatus vectensis* Spath. One may conclude that the investigated specimen presents a form transitional between *I. ellipticus radiatus* and *I. alternatus vectensis.*

Occurrence. — Lower to mid-Middle Cenomanian condensed sequence at Annopol, Holy Cross Mts, Poland (*cf.* Text-fig. 3).

Idiohamites sp.
(Pl. 3, Fig. 13)

Material: Calcareous mould, No. Z2.7754—8.

Description. — The whorls are subcircular in costal cross section (Wb: Wh=0.91), with massive, rectiradiate ribs which are most prominent at the outer part of the flank, a little less distinct at the venter, and indistinct in the dorsal area. There are 4 singular ribs between each two bifurcate ones. The latter ribs bifurcate at rather conspicuous ventro-lateral tubercles. In turn, the singular ribs show very weakly developed ventral tubercles. The bifurcate ribs often are completely or partly fused into a single one at the venter. Where the fusion is only partial, there is one prominent ventro-lateral tubercle at each bifurcate rib at one shoulder, and two smaller tubercles at the other.

Remarks. — As indicated by the predominance of relatively massive, widely spaced (5 in number at a whorl fragment equal in length to the costal whorl height), singular ribs, and the occurrence of only ventro-lateral tubercles, the specimen under discussion is representative of the genus *Idiohamites* Spath. However, the specimen displays also bifurcate ribs split at the ventro-lateral tubercles, i.e. like in *Anisoceras auberti* (Pervinquière) (*cf.* Pl. 3, Fig. 9*a*—*b*), which characteristic makes it close to the genus *Anisoceras* Pictet. One may conclude that this is a form of *Idiohamites* with some morphological characteristics of *Anisoceras*, as it is the case with Upper Albian specimens from Saint Croix section (*cf.* Renz 1968, pp. 70—71).

Occurrence. — Middle Cenomanian, MGU Station, Band *IV-2* (Bed *3*), Crimea (*cf.* Text-fig. 6).

Superfamily Turrilitaceae Meek, 1876
Family Turrilitidae Meek, 1876

Remarks. — The family Turrilitidae Meek, 1876, and especially its Albian to Cenomanian representatives, is concisely and comprehensively discussed by Klinger & Kennedy (1978). The present author's collection includes genera considered in detail by the latter authors and hence, the author's comments deal merely with specific-level taxa.

Genus *TURRILITES* Lamarck, 1801
Subgenus *TURRILITES* Lamarck, 1801
(Type species: *Turrilites costatus* Lamarck, 1801)
Turrilites (Turrilites) costatus Lamarck, 1801
(Pl. 4, Figs 1—13)

1822. *Turrilites costatus*, Sow.; Brongniart, p. 395, Pl. 7, Fig. 4.
1822. *Turrilites costatus*; Mantell, pp. 123—124, Pl. 23, Fig. 15, Pl. 24, Figs 1 and 4—5.
1852. *Turrilites costatus* Lmk.; Bronn, pt. 5, p. 335, Pl. 33, Fig. 7.
1870. *Turrilites costatus* Lam.; Roemer, p. 293, Pl. 27, Fig. 2.
1970. *Turrilites costatus* Lamarck, 1801; Marcinowski, p. 432 [*cum syn.*].
1977. *Turrilites costatus* Lamarck; Terekhova & Mikhailova, p. 54, Pl. 1, Figs 1—8.
1978. *Turrilites (Turrilites) costatus* Lamarck, 1801; Klinger & Kennedy, p. 7, Text-fig. 4A, Pl. 3, Figs F and K [*cum syn.*].

Material: Three hundred specimens, Nos *II.A-4* (Pl. 4, Fig. 1), *II.A-2* (Pl. 4, Fig. 2), *II.A-3* (Pl. 4, Fig. 3), *II.B-2* (Pl. 4, Fig. 4), *II.B-3* (Pl. 4, Fig. 5), *II.A-1* (Pl. 4, Fig. 6), *II.B-1* (Pl. 4, Fig. 7), *II.B/A* (Pl. 4, Fig. 8), *II.D-1* (Pl. 4, Fig. 9), *II.D-2* (Pl. 4, Fig. 10), *Tr 43* (Pl. 4, Fig. 11), *1c.2588-3/3* (Pl. 4, Fig. 12), *1b.2588-3/2* (Pl. 4, Fig. 13), *II.E*, *1d.2588-3/4*, *8.7753-4*, *11.7009a*, *12.7756-7/1*, and others labelled with the symbols *II.A*, *II.B*, or *II.D*.

Remarks. — The shell is ornamented with ribs confined to the upper part of the outer whorl face, and two lower rows of much smaller, variable in size and shape tubercles. The smallest tubercles are those of the lowermost row, often covered with the succeeding whorl. In contrast to the upper tubercles, the lower ones are flattened consistently in direction with the suture between the whorls.

There is little intraspecific variation. The apical angle ranges from 18 to 24°. There is also some variation in more or less oblique position of tubercles relative to the ribs, and in their mutual size relations. A few specimens (Pl. 4, Figs 9—10) tend to develop pointed tubercles rather than ribs in the upper part of the outer whorl face, which makes them close to *Turrilites (T.) acutus* Passy. The latter species is however distinctive in its much greater apical angle.

Occurrence. — No. *Tr 43;* supposedly upper Lower Cenomanian to lower Middle Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2); No. *8.7753-4:* uppermost Lower Cenomanian, MGU Station, Band *IV-1* (Bed *2*), *Crimea* (cf. Text-fig. 6); Nos *1b.2588-3/2*, *1c.2588-3/3*, *1d.2588-3/4:* Middle Cenomanian, southern slope of the Mt. Selbukhra, marls with limestone debris, Band *IV-2* (basal part), Crimea (*cf.* Text-fig. 6); No. *12.7756-7/1:* Middle Cenomanian, MGU Station, Band *IV-2* (Bed 5), Crimea (*cf.* Text-fig. 6); *No. 11.7009a:* Middle Cenomanian, MGU Station, Band *IV-2*, Crimea (*cf.* Text-fig. 6); all the specimens labelled with the symbols *II.A*, *II.B*, *II.D*, *II.B/A*, *II.E:* Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *7—9*, Mangyshlak (*cf.* Text-fig. 12).

The species *Turrilites (T.) costatus* Lamarck shows a world-wide distribution, having been recorded in the Cenomanian of Europe, Asia, Africa, North America, and Australia (*cf.* Kennedy & Cobban 1976, Text-fig. 12). As noted by Klinger & Kennedy (1978, p. 7), „It first appears just below the Lower/Middle Cenomanian boundary, and is most common in the low Middle Cenomanian, but ranges to the low Upper Cenomanian". In the section at MGU Station, Crimea, the species also appears just below the Lower/Middle Cenomanian boundary and persists in the Middle Cenomanian (*cf.* Text-fig. 6).

Turrilites (Turrilites) scheuchzerianus Bosc, 1801
(Pl. 4, Figs 14—15)

1840—1842. *Turrilites Desnoyersi*, d'Orbigny; d'Orbigny, pp. 601—602, Pl. 146, Figs 1—2.
1840—1842. *Turrilites Scheuchzerianus*, Bosc; d'Orbigny, pp. 602—604, Pl. 146, Figs 3—4.
1955. *Turrilites (Euturrilites) scheuchzerianus* Bosc; Reyment, p. 13, Pl. 1, Fig. 2.
1957. *Turrilites (Euturrilites) scheuchzerianus* Bosc; Reyment, pp. 56—57, Pl. 10, Fig. 6.
1965. *Turrilites scheuchzerianus* Bosc; Reyment, p. 33, Pl. 2, Fig. 1.
1966. *Euturrilites scheuchzerianus* Bosc emend. Sharpe; Collignon, pp. 24—25, Pl. 12, Fig. 1 [*cum syn.*].
1970. *Turrilites scheuchzerianus* Roissy; Marcinowski, pp. 432—433, Pl. 3, Figs 11—12 [*cum syn.*].
1976. *Turrilites (Euturrilites) scheuchzerianus* Bosc; Wiedmann & Kauffman, Pl. 4, Fig. 2.
1976. *Turrilites scheuchzerianus* Bosc; Kennedy, p. 22, Pl. 8, Fig. 5.
1977. *Turrilites desnoyersi* Orbigny; Terekhova & Mikhailova, pp. 54—56, Pl. 1, Fig. 4.
1978. *Turrilites (Turrilites) scheuchzerianus* Bosc, 1801; Klinger & Kennedy, p. 10, Text-fig. 3B-C, Pl. 2, Figs F and H [*cum syn.*].

Material: Four incomplete specimens, Nos *II.C* (Pl. 4, Fig. 14), *Tr 44* (Pl. 4, Fig. 15), *II.S-49*, and *II.S-50*.

Remarks. — There is an ontogenetic change in shell ornamentation in *Turrilites (T.) scheuchzerianus* Bosc. Ribs are interrupted at the mid-flank on older (upper) whorls, whereas they are continuous on younger (lower) whorls (Sharpe 1857, p. 64; Schlüter 1876, p. 124). This difference in ornamentation between juvenile and adult stages induced d'Orbigny (1840—1842) to split this species into two. In fact, the change in ornamentation is going on very rapidly, as both the types of ribs often co-occur at a single whorl (*cf.* Pl. 4, Fig. 15).

Occurrence. — No. *Tr 44:* Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2); Nos *II.C, II.S-49, II-S-50:* Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *8—9* and possibly Band 7, Mangyshlak (*cf.* Text-fig. 12).

The species *Turrilites (T.) scheuchzerianus* Bosc shows a world-wide distribution, having been reported from the Cenomanian of Europe, Asia, Africa and Madagascar, and North America.

Genus *NEOSTLINGOCERAS* Klinger & Kennedy, 1978
(Type species: *Turrilites carcitanensis* Matheron, 1842)
Neostlingoceras carcitanense (Matheron, 1842)
(Pl. 4, Fig. 16)

1960. *Hypoturrilites carcitanensis* (Matheron); Chiriac, pp. 459—460, Pl. 3, Fig. 29 [*cum syn.*].
1971. *Hypoturrilites carcitanensis* (Matheron); Kennedy, pp. 23—24, Pl. 6, Figs 1—2 and 4—10 [*cum syn.*].
1976. *Hypoturrilites carcitanensis* (Matheron); Kennedy & Hancock, p. 37, Pl. 4, Figs 8—10.
?1976. *Hypoturrilites carcitanensis* (Matheron); Lewy & Raab, p. 16, Pl. 2, Fig. 3.
1978. *Neostlingoceras carcitanense* (Matheron, 1842); Klinger & Kennedy, pp. 15—17, Text-figs 5C, 6B-C, Pl. 3, Fig. G, and Pl. 4, Fig. D.

Material: Phosphatized half whorl, No. *A.H.M.3.*

Description. — The specimen shows a very strongly crenulate suture at the whorl contacts, and large-sized, pointed tubercles (5 in number per half whorl) in the uppermost row linked together by a fine spiral ridge. Tubercles making part of the other three rows, situated close to one another, are smaller-sized and more numerous (9 in a row per half whorl). There is a wide and gentle concavity between the uppermost row of tubercles and the adjacent one. The remaining two rows lie so closely to each other that they almost make up a single row.

Remarks. — The specimen is entirely consistent with the diagnosis of *Neostlingoceras carcitanense* (Matheron). It resembles most closely the specimens illustrated by Kennedy (1971, Pl. 6, Figs 2 and 6) and Klinger & Kennedy (1978, Text-fig. 5C).

Occurrence. — Lower to mid-Middle Cenomanian condensed sequence at Annopol, Holy Cross Mts, Poland (*cf.* Text-fig. 3).

The species *Neostlingoceras carcitanense* (Matheron) occurs frequently in the lowermost Cenomanian of southern England and northern France where it is the index species of the lowest Cenomanian assemblage Zone (*sensu* Kennedy 1971, Kennedy & Juignet 1975). It has been recorded also in the Lower Cenomanian of GFR, Rumania, Yugoslavia, northern and southern Africa and Madagascar, and Asia (Kopet-Dag, Japan, and supposedly southern India).

Genus *HYPOTURRILITES* Dubourdieu, 1953
(Type species: *Turrilites gravesianus* d'Orbigny, 1842)
Hypoturrilites tenouklensis (Pervinquière, 1910)
(Pl. 4, Fig. 17)

1910. *Turrilites tuberculato-plicatus* Seguenza, var. *Tenouklensis* Pervinquière 1910; Pervinquière, pp. 57—58, Pl. 5, Fig. 31.
1971. *Hypoturrilites tenouklensis* (Pervinquière); Kennedy, pp. 24—25.

Material: Well preserved, although slightly deformed specimen, *No.* 207.5999.

Remarks. — The specimen is consistent with the original diagnosis and illustration given by Pervinquière (1910, p. 57, Pl. 5, Fig. 31), except for a little greater number of large tubercles which are 15 in number per whorl, while there are 12—13 tubercles per whorl in the holotype.

The species *Hypoturrilites tenouklensis* (Pervinquière) shows tubercles associated with fine ribs on the outer whorl face. This type of ornamentation is shared with *H. cunliffeanus* (Stoliczka, 1866), *H. tuberculatoplicatus* (Seguenza, 1882), *H. nodiferus* (Crick, 1907), and *H. gravesianus betaitraensis* Collignon, 1964. Morphological differences among the members of this group of species are discussed by Pervinquière (1910, pp. 57—58), Dubourdieu (1953, pp. 65—66), and Klinger & Kennedy (1978, pp. 20 and 23).

Occurrence. — Lower Cenomanian, MGU Station, Band *IV-1*, Crimea (*cf.* Text-fig. 6).

The species *Hypoturrilites tenouklensis* (Pervinquière) has thus far been reported from the Lower Cenomanian of Algeria and southern England. In the latter area, it occurs at the top of the Lower Cenomanian (Kennedy 1971, p. 25), as it is also the case in Crimea (*cf.* Text-fig. 6).

Hypoturrilites gravesianus cf. *gravesianus* (d'Orbigny, 1842)

Material: Whorl fragment, No. *Tr 49a.*

Remarks. — The upper tubercles are very large-sized and widely spaced, twice less numerous than those constituent of the remaining three rows, which is suggestive of the attribution of the specimen to the subspecies *gravesianus*.

However, the specimen is so fragmentary that it cannot be identified with certainty.

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

Hypoturrilites tuberculatus (Bosc, 1801)
(Pl. 4, Fig. 18)

1960. *Hypoturrilites tuberculatus* (Bosc); Chiriac, pp. 461—462, Pl. 3, Figs 33—34 [*cum syn.*].
1971. *Hypoturrilites tuberculatus* (Bosc); Kennedy, p. 24, Pl. 6, Fig. 11 (*partim*, only lower whorls), Pl. 42, Fig. 2 [*cum syn.*].
1978. *Hypoturrilites tuberculatus* (Bosc, 1801); Klinger & Kennedy, p. 22, Text-fig. 6F [*cum. syn.*].

Material: Three whorl fragments, Nos *Tr 49* (Pl. 4, Fig. 18), *Tr 45*, and *Tr 46*.

Remarks. — The investigated specimens show tubercles of the uppermost row being much larger-sized and less numerous than those constituent of the remaining three rows. Their numerical ratios in the investigated whorl fragments are as follows: 10: 13 (in *Tr 45*), 11: 15 (in *Tr 46*), and 13: 17 (in *Tr 49*).

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Hypoturrilites tuberculatus* (Bosc) has been recorded in the Lower Cenomanian of Europe (England, France, GFR, GDR, Switzerland, Poland, and Rumania), Africa (the Zululand) and Madagascar, Asia (Kopet-Dag, India), and possibly North America (Texas).

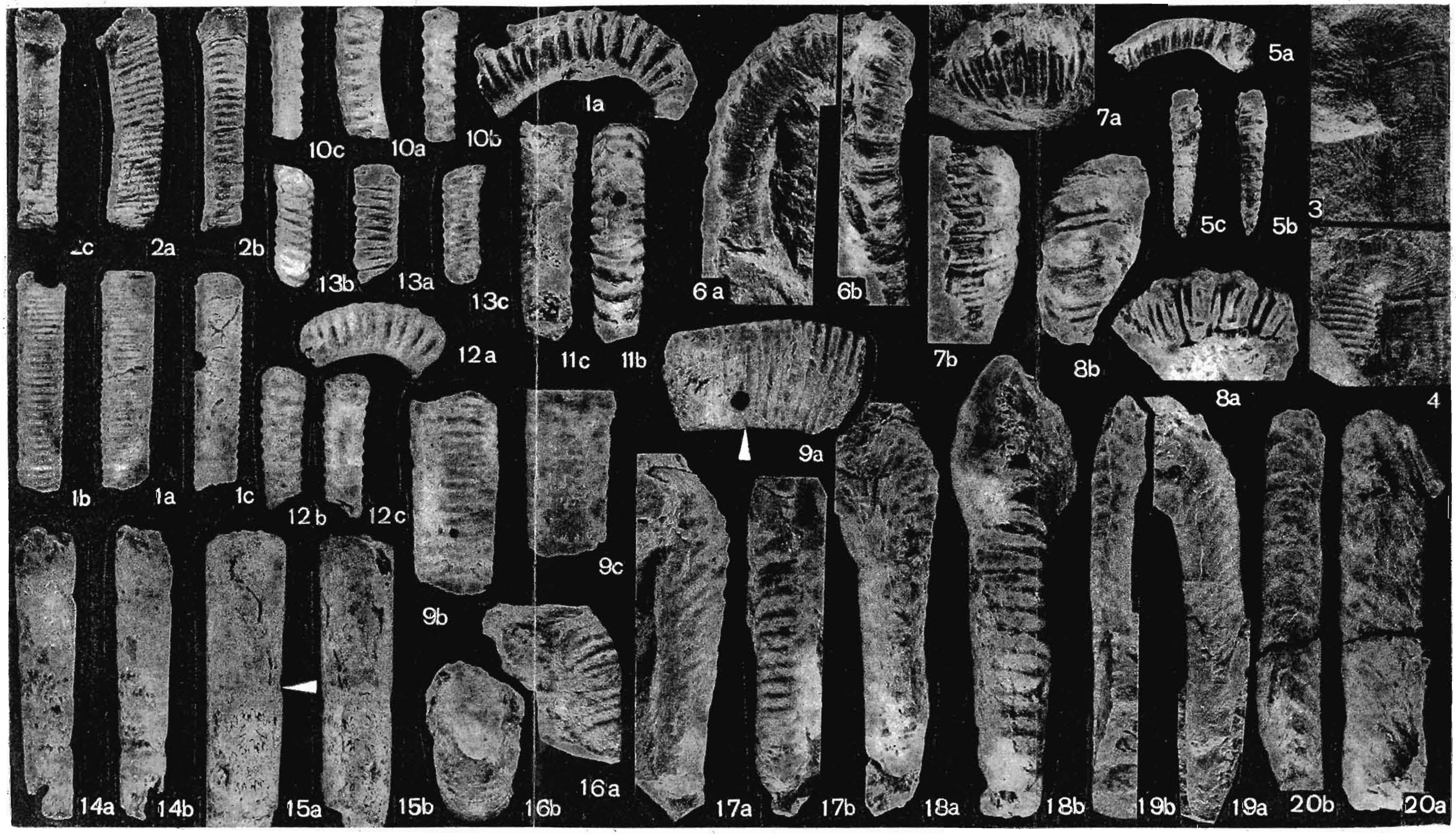
Hypoturrilites? polytuberculatus (Mikhailova & Terekhova, 1977)
(Pl. 4, Figs 19—20)

1977. *Turrilites polytuberculatus* I. Michailova et Terechova, sp. nov.; Terekhova & Mikhailova, pp. 56—58, Pl. 2, Figs 1—5.

Material: Three specimens, one of which almost completely preserved, Nos *Tr 47* (Pl. 4, Fig. 19), *Tr 50* (Pl. 4, Fig. 20), and supposedly *Tr 48*.

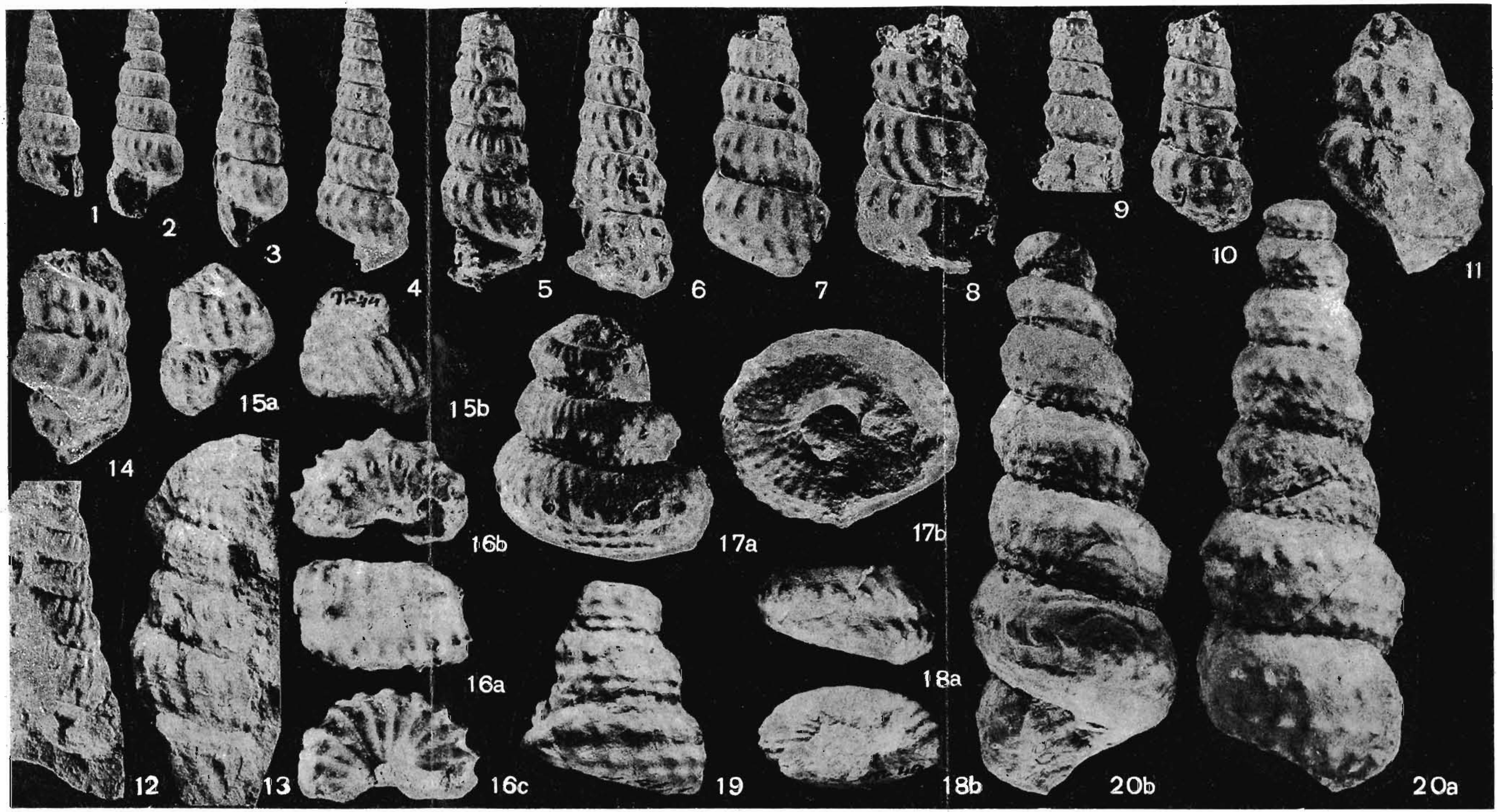
Discussion. — The species *polytuberculatus* Mikhailova & Terekhova originally was arbitrarily assigned to the genus *Turrilites* Lamarck, as it appeared incompatible with any thus far known turilitid genus (Terekhova & Mikhailova 1977, p. 58). The present author is of the opinion that this is a transitional form, showing characteristics of the genus *Mariella* Nowak, as well as features typical of *Hypoturrilites* Dubourdieu. Hence, it is here tentatively attributed to the latter genus. In fact, the number of tubercles per whorl is constant in all the four rows in the investigated specimens, and their size is only slightly variable in the upper three rows, which characters are typical of the genus *Mariella*. In turn, the tubercles tend to become more and more clavate in the lower three rows, the lowermost two rows lie very close to each other, and there are no ribs, which characters are typical of the genus *Hypoturrilites*. Shall these features be found to co-occur in several specimens, a new taxon of at least subgeneric rank will be needed for those transitional forms.

Description. — The specimen No. *Tr 50* (Pl. 4, Fig. 20) shows the apical angle of 21°, as measured on its 6.5 preserved whorls. There are four rows of tubercles on the outer whorl face, each one with equal number of tubercles (16, 15, 19, 23, 23 and 24 in number per whorl in upward order). The uppermost tubercles are the largest-sized, but the difference in size from the tubercles constituent of the second and third rows is only a small one. The lowermost tubercles are the



Hamites (Stomohamites) duplicatus Pictet & Campiche: 1 — specimen No. A.H.M.3, Cenomanian condensed sequence at Annopol, × 1.5; 2 — No. II.St.9, Middle Cenomanian, Sullu-kapy, upper part of Band 8 and Band 9 (*II* faunal horizon), × 2. **Hemiptychoceras gaultinum subgaultinum** Breistroffer: 3 — specimen No. 10.31, 4 — No. 9a.8149-1/1; probably Lower Cenomanian, Mt. Kremennaya, ?Bands II—III, × 2. **Anisoceras plicatile** (J. Sowerby): 5 — specimen No. II.An.1, Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon), × 2; 6 — No. 20.7754-2, low Middle Cenomanian, MGU Station, Band IV-2 Bed 3 or 4, × 1.5; 7 — No. 25.82a/1, Middle Cenomanian, Ajmaki, × 1; 8 — No. 33.6024a/1, low Middle Cenomanian, Mt. Selbukhra, Band IV-2 Bed 3 or 4, × 1. **Anisoceras auberti** (Pervinquière): 9 — specimen No. A.H.M.9 Cenomanian condensed sequence at Annopol, × 1.5. **Idiohamites alternatus vectensis** Spath: 10 — specimen No. A.H.M.7, 11 — No. A.H.M.5; Cenomanian condensed sequence at Annopol, × 1.5. **Idiohamites aff. ellipticus radiatus** Spath: 12 — specimen No. A.H.M.6, Cenomanian condensed sequence at Annopol, × 1.5. **Idiohamites** sp.: 13 — specimen No. 22.7754-8, Middle Cenomanian, MGU Station, Band IV-2 Bed 3, × 1.5. **Sciponoceras roto** Cieśliński: 14 — specimen No. II.Sci.2, Middle Cenomanian, Sullu-kapy, Bands 7—8 (*II* faunal horizon), × 1.5; 15 — No. A.R.M.4, Upper Cenomanian, Annopol, a few centimetres above the hardground, × 1.5. **Sciponoceras** sp.: 16 — specimen No. 23e.86a/16, Middle Cenomanian, Ajmaki, × 1. **Sciponoceras baculoide** (Mantell) (*17—19* microconchs, *20* macroconch): 17 — specimen No. 16.7755-9/3, 18 — No. 14.7755-9/1, 19 — No. 15.7755-9/2, 20 — No. 18.7755-9/5; low Middle Cenomanian, MGU Station, Band IV-2 Bed 4, ×1.

a lateral, *b* ventral, *c* dorsal views; arrow indicates the end of the phragmocone



Turrilites (Turrilites) costatus Lamarck: 1 — specimen No. II.A-4, 2 — No. II.A-2, 3 — No. II.A-3, 4 — No. II.B-2, 5 — No. II.B-3, 6 — No. II.A-1, 7 — No. II.B-1, 8 — No. II.B/A, 9 — No. II.D-1, 10 — No. II.D-2; Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon); 11 — No. Tr 43, high Lower or low Middle Cenomanian, Hoppenstedt; 12 — No. 1c.2588-3/3, 13 — No. 1b.2588-3/2; Middle Cenomanian, Mt. Selbukhra, base of Band IV-2. **Turrilites (Turrilites) scheuchzerianus** Bosc: 14 — specimen No. II.C (with ribs interrupted at mid-flank), Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon); 15 — No. Tr 44 (*15a* older part of the whorl with ribs interrupted at mid-flank, *15b* younger part of the whorl with continued ribs), Lower Cenomanian, Hoppenstedt. **Neostlingoceras carcitanense** (Matheron): 16 — specimen No. A.H.M.2 (*16a* outer face of the whorl, *16b* upper and *16c* lower face of the whorl), Lower Cenomanian condensed sequence at Annopol. **Hypoturrilites tenouklensis** (Pervinquière): 17 — specimen No. 207.5999, Lower Cenomanian, MGU Station, Band IV-1. **Hypoturrilites tuberculatus** (Bosc): 18 — specimen No. Tr 49, Lower Cenomanian, Hoppenstedt. **Hypoturrilites? polytuberculatus** (Mikhailova & Terekhova): 19 — specimen No. Tr 47 (cast), 20 — No. Tr 50; Lower Cenomanian, Hoppenstedt

Figs 11—13, 15, 17—20 are of natural size, the others are × 1.5

smallest-sized, situated at the suture at the whorl contacts. The distances between the upper three rows of tubercles gradually decrease downwards, but the lowermost row lies very close to the third one. The whorls are rounded pentagonal in cross section, with relatively convex outer whorl face.

The same morphological characteristics are shown also by the specimen No. *Tr 47* (Pl. 4, Fig. 19) although they are obscured by its considerable diagenetical flattening.

Remarks. — One of the investigated specimens (Pl. 4, Fig. 20) resembles very closely the holotype of *Hypoturrilites? polytuberculatus* (Mikhailova & Terekhova), the latter specimen showing in average 19 tubercles in a row per whorl (*cf.* Terekhova & Mikhailova 1977, pp. 56—58, Pl. 2, Fig. 1). The species *H.? polytuberculatus* (Mikhailova & Terekhova) differs from *Mariella* (M.) *lewesiensis* (Spath) mainly in the absence of ribbing and the orientation of tubercles constituent of the lower two rows. In turn, it differs from *H. mantelli* (Sharpe) in less numerous tubercles and especially, in their number per whorl being constant in all the rows. The latter character, as well as small differences in tubercle size between the upper two rows make up a difference between *H.? polytuberculatus* and *H. tuberculatus* (Bosc). There are specimens of *H. mantelli* with only 22 tubercles per whorl in the uppermost row but nevertheless, they show a little more numerous tubercles (25 in number per whorl) in the remaining three rows (*cf.* Renz 1963, p. 1093, Pl. 1, Fig. 9) than does the species under discussion. Therefore, one may doubt whether Kennedy (1971, pp. 22—23) was right when claiming that the specimen described by Renz as „with equal number of tubercles in all rows may be transitional to *Mariella*".

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Hypoturrilites? polytuberculatus* (Mikhailova & Terekhova) occurs also in the Middle? Cenomanian of the Anadyrsko-Koyarskyi region, Far East of the Soviet Union, where it is associated with *Turrilites (T.) costatus* Lamarck, *T. (T.) scheuchzerianus* Bosc, *T. (T.) dilleri* Murphy & Rodda, *Hypoturrilites anadyrensis* Mikhailova & Terekhova, *Anagaudryceras buddha* (Forbes), *Parajaubertella kawakitana* Matsumoto, *Tetragonites rectangularis* Wiedmann, and *Marshallites olcostephanoides* Matsumoto. That ammonite association was recognized by Terekhova & Mikhailova (1977, p. 50) for indicative of the *Turrilites costatus* Zone; there is however little doubt that the zone is meant much more widely than it is in Europe, as it is considered as equivalent to the whole Lower Cenomanian in the bipartite subdivision of the stage applied in that area.

Genus *MARIELLA* Nowak, 1915
Subgenus *MARIELLA* Nowak, 1915
(Type species: *Turrilites bergeri* Brongniart, 1822)
Mariella (Mariella) cf. *lewesiensis* (Spath, 1926)

Material: Considerably flattened specimen, No. 8043-1/1.

Remarks. — The specimen shows tubercles in four rows, almost equal in size in the upper three rows which characteristics make it close to *Mariella (M.) lewesiensis* (Spath) (*cf.* Kennedy 1971, p. 28). However, the specimen is too poorly preserved to be identified with certainty.

Occurrence. — Lower Cenomanian, Sukhoy ravine, 200 m north of the LGI (Leningrad Geological Institute) Field Station, green, glauconitic-sandy marls close to the Albian/Cenomanian boundary, Band *I*, southwestern Crimea Highland.

Superfamily Scaphitaceae Meek, 1876
Family Scaphitidae Meek, 1876
Genus *SCAPHITES* Parkinson, 1811
Subgenus *SCAPHITES* Parkinson, 1811
(Type species: *Scaphites equalis* J. Sowerby, 1813; by the subsequent designation of Meek, 1876)

Diagnosis: See Wiedmann (1965, pp. 411—412) and Kennedy (1971, p. 33).

Discussion. — Wiedmann (1965) distinguished three evolutionary lineages (the „*equalis*", „*similaris*", and „*meriani*" stocks) within the nominative subgenus *Scaphites* Parkinson, showing parallel evolutionary trends. The present author's collection includes representatives of only two of these lineages, the „*equalis*" and „*similaris*" stocks, which shall therefore be discussed in more detail.

According to Wiedman (1965), the „*equalis*" main stock includes the species *Scaphites (S.) simplex* Jukes-Browne, *S. (S.) obliquus* J. Sowerby, and *S. (S.) equalis* J. Sowerby, which are counterparted in the „*similaris*" stock by similarly ornamented but much smaller-sized species *S. (S.) hilli* Adkins & Winton, *S. (S.) yonekurai* Yabe, and *S. (S.) similaris* Stoliczka, respectively. The present author is of the opinion that shell size is of much diagnostic value in the genus *Scaphites* Parkinson, because where the body chamber (=shaft and hook) is present it sets the limit to shell growth (further growth would require shell resorption, which hypothesis is inacceptable). Wiedmann (1965) considered the work of Makowski (1962b) but none the less, did not refer the observed difference in shell size between the two stocks to sexual dimorphism. He wrote, „*S. similaris* and its allies will be regarded as an atrophic parallel development to the main stock, which evidently favoured the boreal coldwater" (Wiedmann 1965, p. 421). More recent studies demonstrated, however, the co-occurrence of representatives of the two stocks (*cf.* Juignet & Kennedy 1976, Seyed-Emami 1977, Tanabe 1977a, Kennedy & *al.* 1979).

One may conclude that some representatives of the „*equalis*" and „*similaris*" stocks occur in couples, being similar, if not indistinguishable in shell ornamentation, and separated only by a distinct size gap. Fence, they show sexual dimorphic characteristics and are to be lumped each couple into a single species (*cf.* Makowski 1962a; 1962b, pp. 31—34, Text-Pl. 4). It is to be noted that in the genus *Scaphites* Parkinson sexual dimorphism may be expressed not only in size difference between conspecific micro- and macroconchs, but also in considerable differences in shell ornamentation (*cf.* Cobban 1969, Hook & Cobban 1979).

Occurrence. — The subgenus *Scaphites* Parkinson shows a world-wide distribution, having been recorded in the Upper Albian to Upper Campanian of Europe, Asia (Soviet Union, Iran, India, Japan), Africa and Madagascar, northern Australia and New Zealand, North America.

Scaphites (Scaphites) obliquus J. Sowerby, 1813
(Pl. 5, Figs 1—5)

1822. *Scaphites striatus;* Mantell, pp. 119—120, Pl. 22, Figs 3—4, 9, 11, and 13—16.
1959. *Scaphites aequalis* Sowerby; Cieśliński, pp. 32—34, Pl. 3, Fig. 4.
1959. *Scaphites aequalis* Sowerby; Naidin & Shimanskij [*partim*], p. 184, Pl. 7, Fig. 2.
1965. *Sc. (Scaphites) obliquus* J. Sowerby; Wiedmann, pp. 415—417, Text-fig. 3c, Pl. 56, Figs 5—6 [*cum syn.*].
1965. *Sc. (Scaphites) yonekurai* Yabe; Wiedmann [*partim*], pp. 421—422, Text-fig. 3d, Pl. Fig. 7.
1970. *Scaphites aequalis* Sowerby, 1813; Marcinowski, pp. 428—429, Pl. 2, Figs 5—6.
1971. *Scaphites obliquus* J. Sowerby; Kennedy, p. 33, Pl. 63, Fig. 2, and Pl. 64, Figs 2—4.
1976. *Scaphites (Scaphites) obliquus* J. Sowerby; Juignet & Kennedy, p. 69, Pl. 4, Figs 8—10 and 12.
1977. *Scaphites obliquus* Sowerby; Seyed-Emami, p. 132, Pl. 13, Figs 5—6.
1977. *Scaphites yonekurai* Yabe; Seyed-Emami, pp. 133—134, Pl. 13, Figs 12 and 15—17.
1979. *Scaphites (Scaphites) obliquus* J. Sowerby, 1813; Kennedy, Chahida & Djafarian, pp. 22—23, Pl. 2, Figs 4—5 and 11.
1979. *Scaphites obliquus* J. Sowerby; Wiedmann & Schneider, p. 659, Pl. 4, Fig. 5.

Material: A dozen specimens, Nos *46.1* (Pl. 5, Fig. 1), *46.2* (Pl. 5, Fig. 2), *41.7755-7/1* (Pl. 5, Fig. 3), *40.7631-1/1* (Pl. 5, Fig. 4), *75.6036a* (Pl. 5, Fig. 5), *26.82a*, *31.8089-2*, *35.b/n-1*, *38.13*, *38.13a*, and *39.7631-1/2*.

Table 7

Specimen No.	D mm	Wb mm	d mm	wh %	wb %	u %	wb/wh
	m i c r o c o n c h						
75.6036a	16.0		9	50.0		24.4	
	m a c r o c o n c h s						
41.7755-7/1	23.0		14.2	49.3		21.8	
46.1	25.6	12.5	16	54.4	61.9	29.4	1.14

Remarks. — There are two morphotypes among the investigated specimens preserved with a body chamber. One of these is represented by individuals ranging from 23 to 30 mm in shell size, with rather strongly ribbed shaft and hook (Pl. 5, Figs 1—3). The specimen No. *41.7757-7/1* (Pl. 5, Fig. 3), with densely spaced and conspicuous primary ribs on the body chamber, is almost indistinguishable from the lectotype of *Scaphites striatus* Mantell, the latter name being a junior synonym of *Scaphites obliquus* J. Sowerby (*cf.* Kennedy 1971, Pl. 64, Fig. 2). The observed variation in rib conspicuousness and density, which is in part due to the preservation state (the ribs are less distinct in phosphatic than in marly or calcareous moulds; *cf.* Pl. 5, Figs 1—2 and 3—4, respectively), falls within the range of intraspecific variability (*cf.* the illustrations *in* Wiedmann 1965, Kennedy 1971, Juignet & Kennedy 1976, Kennedy & *al.* 1979).

The other morphotype includes specimens ranging from 16 to 20 mm in shell size, with body chamber covered with densely spaced, fine ribs (Pl. 5, Figs 4—5). Both primary and secondary ribs are as distinct in proximity of the ventro-lateral edge as at the venter (*cf. also* Naidin & Shimanskij 1959, Pl. 7, Fig. 2). The two morphotypes co-occur, *e.g.* in the Middle Cenomanian of the Mt. Selbukhra, southwestern Crimea Highland.

Discussion. — The two morphotypes of *Scaphites obliquus* differ in shell size, by the factor of 2 at the extreme case, as well as in ornamentation of body chamber. The present author is of the opinion that this the case of sexual dimorphism, with the specimens Nos *26.82a, 35.b/n-1, 38.13a, 41.7755-7/1, 46.1,* and *46.2* (*cf. also* Pl. 5, Figs 1—3) being macroconchs and the specimens Nos *31.8089-2, 38.13, 39.7631-1/2, 40.7631-1/1, and 75.6036a* (cf. *also* Pl. 5, Figs 4—5) being microconchs. The existence of small-sized and densely ribbed morphological counterparts of *S. obliquus* was pointed out by Wiedmann (1965, pp. 421—422) who assigned them to *S. yonekurai* Yabe. Not all the specimens discussed by Wiedmann can be regarded as representative of true *S. yonekurai* (cf. Tanabe 1977a, p. 128; 1977b, p. 14) but none the less, they can be, at least in part, considered as microconchs of *S. obliquus*. Wiedmann (1965, p. 422) included to the synonymy of the species *S. yonekurai* also *S. aequalis-obliquus* Sowerby (*cf.* Collignon 1929, Pl. 5, Figs 1—6) and *S. dailyi* Wright, which is in the present author's opinion incorrect because both the latter forms are to be attributed to *S. basseae* Collignon (*see* below).

Occurrence. — *Nos 46.1, 46.2*: Cenomanian condensed sequence at Mokrzesz, Polish Jura Chain (*cf.* Marcinowski 1974, Text-fig. 2); Nos *39.7631—1/2, 40.7631—1/1*: Lower Cenomanian, marls at the left border of Bodrak river at Trudolubovka, Crimea; No. *38.13a*: Lower Cenomanian, MGU Station, Band *IV-1*, Crimea; No.

26.82a: Middle Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9); No. *41.7755—7/1*: Middle Cenomanian, MGU Station, Band *IV-2* (Bed 4), Crimea (*cf.* Text-fig. 6); No *38.13*: Middle Cenomanian, southern slope of the Mt. Selbukhra, Band *IV-2*, Crimea (*cf.* Text-fig. 6); Nos *31.8089—2*, *35.b/n—1*: Cenomanian, southern slope of the Mt. Selbukhra, Crimea; No. *75.6036a*: Cenomanian, Shara ravine, Crimea.

The species *Scaphites (S.) obliquus* J. Sowerby is widely distributed, having been reported from the entire Cenomanian of West and Central Europe, the Balkans, possibly the Podolia, Crimea, Caucasus, Middle East (Kopet-Dag and Iran), and northern Africa.

Scaphites (Scaphites) equalis J. Sowerby, 1813 (Pl. 5, Fig. 6)

1822. *Scaphites costatus*; Mantell, pp. 120—121, Pl. 22, Figs 8 and 12.
1965. *Sc. (Scaphites) equalis* J. Sowerby; Wiedmann, pp. 417—419, Text-fig. 3a—b, Pl. 56, Figs 1—4 [*cum syn.*].
1965. *Sc. (Scaphites) similaris* Stoliczka; Wiedmann, pp. 422—423 [*cum syn.*].
1977. *Scaphites similaris* Stoliczka; Seyed-Emami, p. 134, Pl. 13, Figs 13—15.
1979. *Scaphites (Scaphites) equalis* J. Sowerby, 1813; Kennedy, Chahida & Djafarian, p. 22, Pl. 2, Fig. 3 [*cum syn.*].

Material: Three shell fragments with body chamber preserved, Nos *53.1a* (Pl. 5, Fig. 6), *53.9*, and *Tr 6*.

Remarks. — The investigated specimens show widely spaced, distinct primary ribs at the flank of the body chamber, which branch each into up to four finer secondary ribs crossing the venter along with one or more, short intercalated ribs (*cf.* Pl. 5, Fig. 6). The species *Scaphites (S.) equalis* J. Sowerby differs from *Scaphites (S.) obliquus* J. Sowerby in its thicker shaft and especially in its distinct primary ribs.

Discussion. — The dimorphic counterpart of *Scaphites (S.) equalis* is *Scaphites (S.) similaris* Stoliczka (microconch) described by Wiedmann (1965, p. 422) as, "evidently a small-sized *Sc. equalis*, with which Stoliczka identified it at first."

Occurrence. — No. *Tr 6*: supposedly Middle Cenomanian, debris with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2); Nos *53.1* and *53.9*: Cenomanian condensed sequence at Jaźwiny, Polish Jura Chain (*cf.* Marcinowski 1974, Text-fig. 2).

The species *Scaphites (S.) equalis* J. Sowerby occurs commonly in the Cenomanian England, France, GFR, GDR, Bohemia, Poland, the Soviet Union (the Podolia, Crimea, Caucasus, Kopet-Dag), and Iran.

Scaphites (Scaphites) basseae Collignon, 1929 (Pl. 5, Figs 7—15)

1907. *Scaphites aequalis* Sow.; Boule, Lemoine & Thevenin, pp. 50—51, Pl. 13, Fig. 6.
1907. *Scaphites obliquus* Sowerby; Pervinquière, p. 118, Pl. 4, Fig. 27.
1929. *Scaphites aequalis-obliquus* Sowerby; Collignon, pp. 49—50, Pl. 5, Figs 1—6.
1929. *Scaphites Bassei* nov. sp.; Collingnon, pp. 51—52, Pl. 5, Figs 8—9.
1929. *Scaphites Hugardianus* d'Orb.; Collignon, p. 53, Pl. 5, Fig. 12.
1929. *Scaphites Falloti* nov. sp.; Collignon, p. 54, Pl. 5, Fig. 14.
1931. *Scaphites Bassei* Coll.; Collignon, p. 46, Pl. 5, Fig. 6.
1955. *Scaphites bassei* Collignon; Sornay, p. 10, Text fig. 3, Pl. 1, Figs 7 and 11.
1963. *Scaphites dailyi* sp. nov.; Wright, p. 602, Pl. 81, Fig. 6.
1964. *Scaphites aequalis-obliquus* J. Sow.; Collignon, pp. 9—10, Pl. 319, Fig. 1376.
1964. *Scaphites simplex* Jukes-Browne; Collignon, p. 10, Pl. 319, Fig. 1378.

1965. *Sc. (Scaphites) hilli* Adkins & Winton; Wiedmann [*partim*], p. 421.
1977a. *Scaphites dailyi* C. W. Wright; Tanabe, pp. 123—128, Text-figs 11—13, Pl. 4, Figs 1—12.
1977a. *Scaphites bassei* Collignon; Tanabe, pp. 128—129, Text-fig. 14, Pl. 4, Figs 13—14.

Material: Some tens of ferruginеous moulds, mostly phragmocones, less commonly complete specimens with partly destroyed body chambers, Nos *II.S.4b* (Pl. 5, Fig. 7), *II.S.4a* (Pl. 5, Fig. 8), *II.S.2* (Pl. 5, Fig. 9), *81.b/n-2* (Pl. 5, Fig. 10), *II.S.3c* (Pl. 5, Fig. 11), *II.S.3a* (Pl. 5, Fig. 12), *II.S.5c* (Pl. 5, Fig. 13), *II.S.5b* (Pl. 5, Fig. 14), *II.S.5a* (Pl. 5, Fig. 15), and others labelled with the symbol *II.S.*

Table 8

Specimen No.	D mm	Wb mm	d mm	wh %	wb %	u %	wb/wh
	microconchs						
II.S.4b			11.5	54.8	63.5	24.3	1.16
II.S.4a			12.7	55.2	86.6		1.57
II.S.2	?20	?11	11.9	54.6	73.9		1.35
	macroconchs						
II.S.3c			11.5	47.8	88.7	16.5	1.85
II.S.3b			12.4	45.2	77.4	19.3	1.71
II.S.3a			13.8	52.9	89.8	19.6	1.70
II.S.5c			14.2	45.2	75.3		1.66
II.S.5b	26.0		14.4	52.0	76.4		1.47
II.S.5a	26.0	?17	14.0	50.0	73.6		1.47

Remarks. — There are two morphotypes in the investigated collection. One of these includes specimens (Pl. 5, Figs 11—15) approximating 25—26 mm in shell size (with body chamber preserved). Lateral bulges at the base of the body chamber almost entirely cover the umbilicus of the spiral portion. The early whorls are low semilunate in cross section, whereas the subadult ones are somewhat higher, with rounded ventral side (*cf.* Pl. 5, Figs 11—13). On the whorl flank, primary ribs are rectiradiate to a little prorsiradiate. They bifurcate below the ventro-lateral edge and intercalar ribs sometimes appear between the secondaries; the ribs incline backwards at the point of bifurcation. The ribs are weakening at the final part of the spiral portion and at the base of the body chamber (*cf.* Pl. 5, Figs 13—15). All these characteristics indicate that the investigated specimens are representative of *Scaphites dailyi* Wright (1963, p. 602, Pl. 81, Fig. 6) which in the present author's opinion is a junior synonym of *S. basseae* Collignon (*see* below).

The other morphotype is represented by specimens (Pl. 5, Figs 7—10) ranging from 17 to 20 mm in shell size. The shell form is as in the former morphotype, except for slight differences in ornamentation and proportions of the spiral portion. In fact, the ribs are finer and more densely spaced in the small-sized forms, which is partly due to a greater number of intercalar ribs; the whorls are higher and subcircular in cross section (*cf.* Pl. 5, Figs 7—8 and 11—13). The ribs do not weaken at the final part of the spire and at the base of the body chamber, as it is the case in the large-sized morphotype (*cf.* Pl. 5, Figs *9a*, *c* and *13a*, *14a*, *15a*). The small-sized morphotype is entirely consistent with the diagnosis of the species *S. basseae* Collignon.

Wiedmann (1965, p. 421) attributed to *S. hilli* Adkins & Winton specimens doubtlessly representative of that species, as well as ones representative of *S. basseae*. The present author is of the opinion that the latter species is not synonymous with *S. hilli*, the difference consisting in the absence of tubercles from its shaft (*cf.* Adkins 1928, Pl. 20, Fig. 3; Clark 1965, Pl. 21, Fig. 4, and Pl. 22, Fig. 4), more prominent umbilical bulges at the base of its body chamber, and shorter shaft and closely adpressed hook which results in a more globular shell.

The specimen No. *81.b/n-2* (Pl. 5, Fig. 10) is diagenetically flattened, but its finer ornamentation on both the spiral portion and the shaft make it close to *S. vellai* of Henderson [1973, p. 95, Text-fig. 10 (1—3)].

Discussion. — The two morphotypes differ mostly in mature shell size (*cf.* Pl. 5, Figs 9—10 and 14—15; *note* that the specimen in Fig. 10 is twice enlarged, while the others are taken ×1.5). This is evident also in the specimens referred to in the synonymy. The small-sized forms (D=10—20 mm, most commonly 15—20 mm) are representative of *Scaphites (S.) basseae* Collignon, while the large-sized ones (D=23—26 mm) are representative of *Scaphites (S.) dailyi* Wright, the difference in size being by the factor of 2.6 at the extreme case (compare the specimen illustrated by Collignon 1931, Pl. 5, Fig. 6 with those in Pl. 5, Figs 14—15 in the present paper). The two morphotypes co-occur in the Sullu-kapy section, Mangyshlak, as well as in Madagascar (*cf.* Tanabe 1977a, p. 129) which supports their interpretation as sexual dimorphs. Consequently, the name *Scaphites (S.) dailyi* Wright is to be considered as a junior synonym of *Scaphites (S.) basseae* Collignon, and microconchs and macroconchs are to be distinguished among the investigated specimens (Pl. 5, Figs 7—10 and 11—15, respectively). It is notable that Wright (1963, p. 602) himself emphasized that, "it is probable that *S. dailyi* is closely related to, and perhaps derived directly from *S. basseae.*"

Occurrence. — Nos *II.S.2*, *II.S.3a*, *II.S.3b*, *II.S.3c*, *II.S.4a*, *II.S.4b*, *II.S.5a*, *II.S.5b*, *II.S.5c*, and some tens of specimens labelled with the symbol *II.S*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands 7—9, Mangyshlak (*cf.* Text-fig. 12); No. *81.b/n-2*: upper Lower Cenomanian or Middle Cenomanian, southern slope of the Mt. Selbukhra, Band *IV-1* or *IV-2*, Crimea (*cf.* Text-fig. 6).

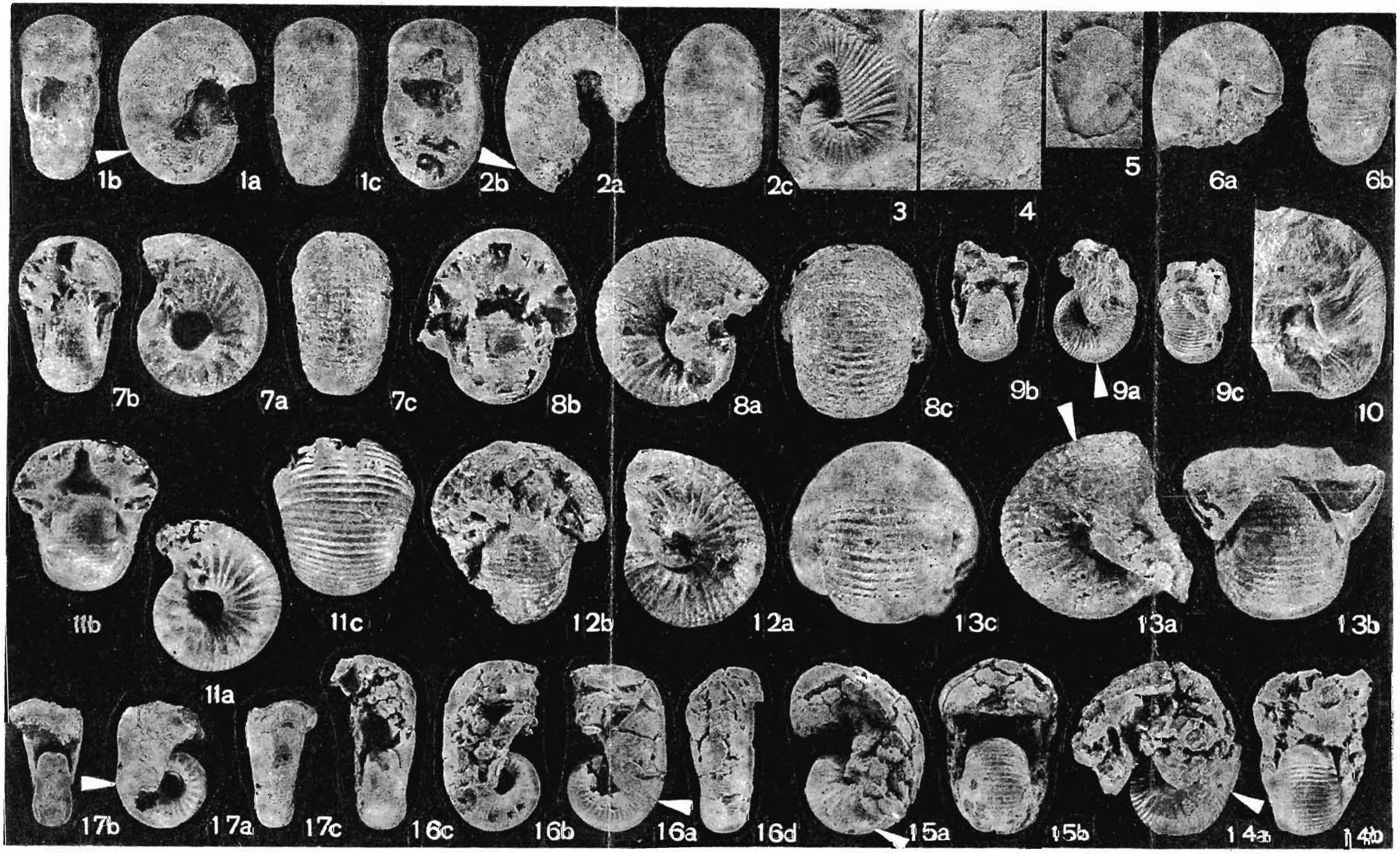
The species *Scaphites (S.) basseae* Collignon may be widespread, but misidentified as *S. equalis* J. Sowerby, in the Cenomanian of Mangyshlak and Kopet-Dag. This is supported by the occurrence of *S. (S.)* cf. *basseae* (specimen No. *6766*) also in the section of the Mt. Koksyrtau, Mangyshlak. The species occurs in the Lower to Middle Cenomanian of Crimea and Mangyshlak in the Soviet Union, northern Africa and Madagascar; it is noteworthy that it has not been recorded in Iran (*cf.* Seyed-Emami 1977, Kennedy & *al.* 1979).

Scaphites (Scaphites) evolutus Pervinquière, 1910
(Pl. 5, Figs 16—17)

1910. ***Scaphites evolutus*** **Pervinquière 1910; Pervinquière, pp. 25—26, Pl. 2, Figs 5—9 (?Text-fig. 9 and Pl. 2, Figs 3—4).**

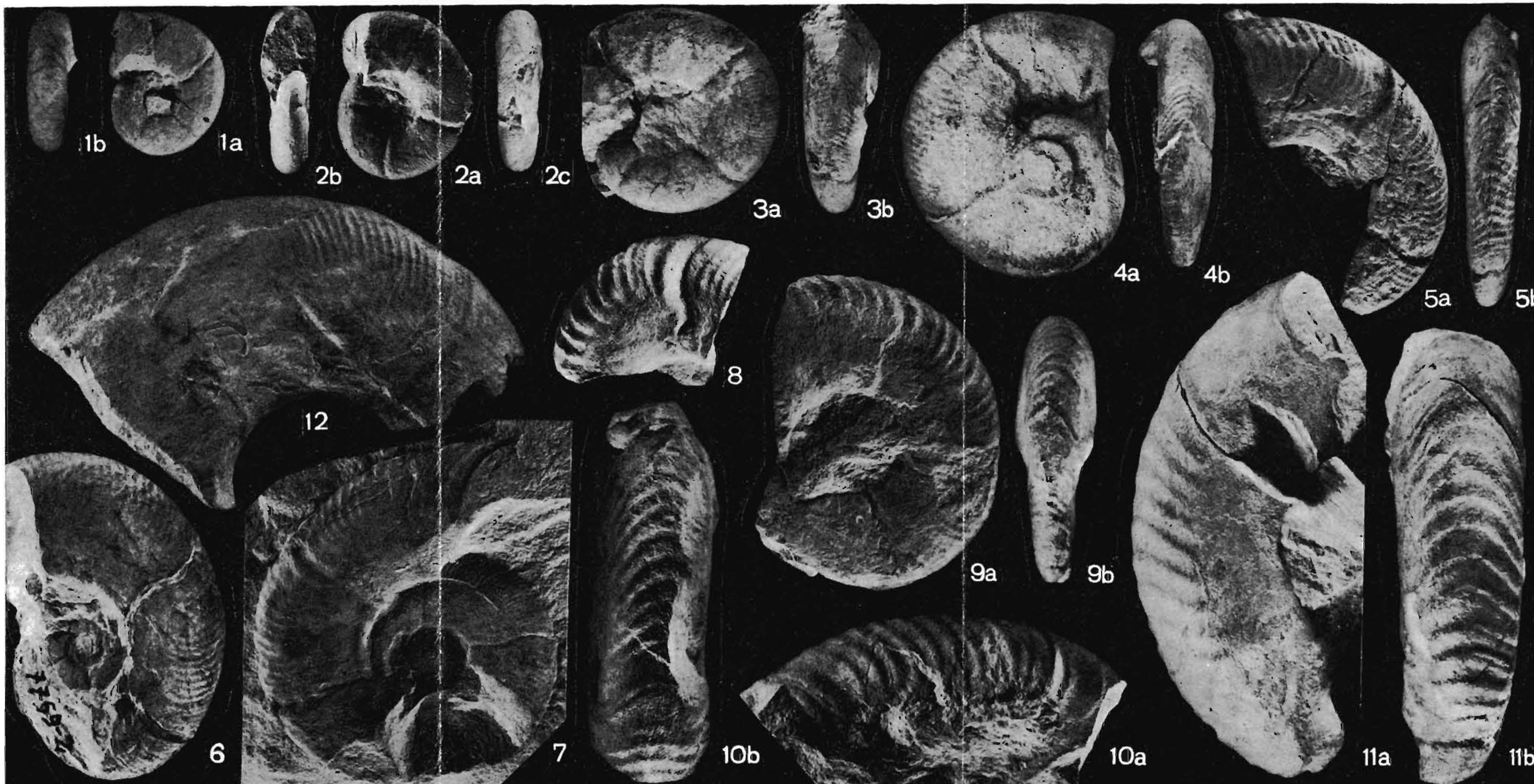
Material**: Two ferrugineous moulds with shaft and a hook fragment preserved, Nos *II.S.49* (Pl. 5, Fig. 16) and *II.S.6* (Pl. 5, Fig. 17).**

Description. — The specimen No. *II.S.6* (Pl. 5, Fig. 17) shows an evolute spiral portion with early whorls ornamented with singular ribs, massive at the whorl flank and weakening at the venter. At the later ontogenetic stages, the ribs



Scaphites (Scaphites) obliquus J. Sowerby (*1—3* macroconchs, *4—5* microconchs): 1 — specimen No. 46.1, 2 — No. 46.2, Cenomanian, condensed sequence at Mokrzesz; 3 — No. 41.7755-7/1, Middle Cenomanian, MUG Station, Band IV-2 Bed 4; 4 — No. 40.7631-1/1, Lower Cenomanian marls in left edge of Bodrak river at Trudolubovka; 5 — No. 75.6036a, Cenomanian, Shara ravine. **Scaphites (Scaphites) equalis** J. Sowerby (macroconch): 6 — specimen No. 53.1a, Cenomanian condensed sequence at Jaźwiny. **Scaphites (Scaphites) basseae** Collignon (*7—10* microconchs, *11—15* macroconchs); except the specimen presented in Fig. 10 the others are from Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon): 7 — specimen No. II.S.4b, inner part of spiral portion; 8 — No. II.S.4a, almost completely spiral portion with umbilical bulges; 9 — No. II.S.2, adult form with fragment of body chamber (shaft); 10 — No. 81.b/n-2, adult form, high Lower of Middle Cenomanian, Mt. Selbukhra, Bands IV-1 or IV-2; 11 — No. II.S.3c, inner part of spiral portion; 12 — No. II.S.3a, inner part of spiral portion; 13 — No. II.S.5c, complete spiral portion with umbilical bulges at the base of body chamber; 14 — No. II.S.5b, 15 — No. II.S.5a, adult forms with epigenetic damage of body chambers. **Scaphites (Scaphites) evolutus** Pervinquière (*16* macroconch, *17* microconch): 16 — specimen No. II.S.49, 17 — No. II.S.6; Middle Cenomanian, Sullu-kapy, Bands 7—9 (*II* faunal horizon)

Figs 1—6, 9, 14—16 are × 1.5, Figs 10, 17 are × 2, Figs 7—8 and 11—13 are × 3; arrow indicates the end of the phragmocone



Puzosia (Puzosia) planulata (J. de C. Sowerby) (*4—6*, *?7* — inner whorls of macroconchs; *8—11* microconchs; *1—3* the innermost parts of phramocones, the morphotypes undeterminable): **1** — specimen No. 212.IV-1, lower Cenomanian, Mt. Selbukhra, Band IV-1; **2** — No. 61.073, Lower or Middle Cenomanian, Mt. Selbukhra; **3** — No. 51.7751-1, Lower Cenomanian, MGU Station, Band IV-1 Bed 1; **4** — No. 52.9107-1, Lower Cenomanian, Mt. Kremennaya, Band IV-1 Bed 1; **5** — No. 137.82a, Middle Cenomanian, Ajmaki, Dagestan; **6** — No. 62.7759-2, Lower Cenomanian, right edge Mender ravine near MGU Station, Band IV-1 Bed 1; **7** — No. 53.77, Lower or Middle Cenomanian, Mt. Kremennaya; **8** — No. 213.IV-1, Lower Cenomanian, Mt. Selbukhra, Band IV-1; **9** — No. 56.7756-3, Middle Cenomanian, MGU Station, Band IV-2 Bed 5; **10** — No. 55.7757-1, Lower Cenomanian, MGU Station, Band IV-1 Bed 1; **11** — No. 214.IV-1, Lower Cenomanian,, MGU Station, Band IV-1. **Puzosia (Austiniceras) austeni** (Sharpe): **12** — specimen No. 209.7757-1, MGU Station, Band IV-1 Bed 1

All figures are of natural size, except Fig. 12 which is $\times 0.5$

Table 9

Specimen No.	D mm	Wb mm	d mm	wh %	wb %	u %	wb/wh
	m i c r o c o n c h						
II.S.6		6.5	9.5	44.2	45.3	33.7	1.02
	m a c r o c o n c h						
II.S.49	24.0	9.0	12.7	50.4	52.7	26.8	1.05

become more and more indistinct and a little prorsiradiate, but slightly inclined backwards just below the rounded ventro-lateral edge. They bifurcate at the point of bending, often with intercalar ribs between the secondaries. The ornamentation is very fine at the final part of the spiral portion and at the shaft. The shaft is short, considerably growing in thickness adaperturally. It partly covers the umbilicus (Pl. 5, Fig. 17*a*). The shaft flank is covered with singular, oblique, inclined forwards, fine, and densely spaced ribs. The ornamentation is mechanically obscured at the venter of the shaft, but the primaries are split down into finer secondaries in proximity of the hook.

The other specimen (Pl. 5, Fig. 16) is almost indistinguishable in shell form from the former one, except for a little smaller evoluteness of its spiral portion. However, it is almost twice greater in size (*note* that the photos differ in enlargement). Its shaft is ornamented with rather fine, oblique, inclined forwards primary ribs, each one divided above the whorl mid-height into 2—4 very fine but sharp secondaries which attain their maximum conspicuousness at the venter (*cf.* Pl. 5, Fig. 16*a,d*). This shaft ornamentation resembles very closely *Scaphites aequalis-obliquus* cf. var. *turonensis* Roman & Mazeran of Collignon (1929, Pl. 5, Fig. 7).

Remarks. — The investigated specimens resemble very closely those typical of *Scaphites (S.) evolutus* Pervinquière (1910, Pl. 2, Figs 5—9) in their very wide umbilicus, short shaft partly covering the umbilicus, low rate of whorl expansion in the spiral portion. The only difference is in their finer and more densely spaced ribbing of the shaft (*cf.* Pervinquière 1910, Pl. 2, Figs 8—9). In the present author's opinion this difference reflects intraspecific variability in *Scaphites (S.) evolutus*.

Discussion. — The investigated specimens are preserved with their body chambers (shaft and partly preserved hook) but they are separated by a considerable size gap. Consequently, they are to be considered as sexual dimorphs, the specimen No. *II.S.6* (Pl. 5, Fig. 17) being the microconch and the other (Pl. 5, Fig. 16) being the macroconch.

Occurrence. — Nos *II.S.6* and *II.S.49:* Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands 7—9 and lower part of Band 8, respectively, Mangyshlak (*cf.* Text--fig. 12).

The species *Scaphites (S.) evolutus* Pervinquière has thus far been reported only from the Middle? Cenomanian of the Aumale region, Algeria.

Suborder **Ammonitina** Hyatt, 1889
Superfamily **Hoplitaceae** Douvillé, 1890

Remarks. — The superfamily Hoplitaceae Douvillé is here meant as by Kullmann & Wiedmann (1970) and Wiedmann (1972) who excluded so-called "false hoplitids" from the Hoplitaceae *sensu* Wright (1957) and recognized them for distinct superfamilies, the Douvilleiceratacea and the Deshayesitaceae, of the suborder Ancyloceratina.

Family **Desmoceratidae** Zittel, 1895
Subfamily **Puzosiinae** Spath, 1922
Genus *PUZOSIA* Bayle, 1878

Remarks. — The present author is of the opinion that four subgenera can be distinguished within the genus *Puzosia* Bayle, namely the nominative subgenus *Puzosia* Bayle and *Austiniceras* Spath, *Anapuzosia* Matsumoto (*cf.* Wright 1957, pp. L365 and L367), and *Mesopuzosia* Matsumoto (*cf.* Cooper 1978, p. 74). The first two of these subgenera are represented in the investigated collection.

Subgenus *PUZOSIA* Bayle, 1878
(Type species: *Ammonites planulatus* J. de C. Sowerby, 1827)

Remarks. — Specimens representative of this subgenus show singular ribs at the outer half of the whorls, moderately evolute shell, and 4—7 constrictions per whorl (*cf.* Matsumoto 1954, p. 70; Wright 1957, p. L365; Renz 1972, p. 704; Cooper 1978, p. 74). All these characteristics are easily discernible in the investigated material.

Occurrence. — The subgenus *Puzosia* Bayle shows a world-wide distribution, ranging from the Lower Albian to Upper Turonian.

Puzosia (Puzosia) planulata (J. de C. Sowerby, 1827)
(Pl. 6, Figs 1—11)

1959. *Puzosia planulata* (Sowerby); Naidin & Shimanskij, p. 184, Pl. 8, Figs 1—2.
1960. *Puzosia mayoriana* Orbigny; Drushtchic, p. 301, Pl. 46, Fig. 10.
1977. *Puzosia mayoriana* d'Orbigny, 1840; Kotetishvili, p. 49, Pl. 16, Fig. 3, Pl. 17, Figs 2—3, Pl. 18, Fig. 2, Pl. 19, Fig. 2, and Pl. 20, Fig. 3.
?1977. *Puzosia* sp. (*1*); Kotetishvili, p. 49, Pl. 16, Fig. 1, Pl. 20, Fig. 2.
1979. *Puzosia (Puzosia) mayoriana* (d'Orbigny, 1841); Immel, pp. 617—618, Pl. 1, Figs 4—5.
1979. *Puzosia (Puzosia) subplanulata* (Schlüter, 1871); Immel, pp. 618—619, Pl. 1, Figs 7—8.
1979. *P. (Puzosia) planulata* (Sowerby, 1827); Scholz, pp. 63—68, Text-figs 19—20, Pl. 11, Figs 9—10, Pl. 12, Figs 1—11, and Pl. 13, Fig. 2 [*cum syn.*].

Material: Some thirty moulds, Nos *212.IV-1* (Pl. 6, Fig. 1), *61.073* (Pl. 6, Fig. 2), *51.7751-1* (Pl. 6, Fig. 3), *52.9107-1* (Pl. 6, Fig. 4), *137.82a* (Pl. 6, Fig. 5), *62.7759-2* (Pl. 6, Fig. 6), *53.77* (Pl. 6, Fig. 7), *213.IV-1* (Pl. 6, Fig. 8), *56.7756-3* (Pl. 6, Fig. 9), *55.7757-1* (Pl. 6, Fig. 10), *214.IV-1* (Pl. 6, Fig. 11), *46.7757-1/1*, *47.7757-1/2*, *48.7757-1/3*, *49.6008-9a*, *50.7757-1/4*, *54.7536-2*, *57*, *58.7811a*, *59.7757-1*, *60*, *60a*, *63.7759-2*, *64.7757-1*, *65.7757-1*, *66.7757-1*, *67.7755-6*, *68.7755-6*, *143.82a*, *144.82a*, *215.IV-1*, *216.IV-1*, and *217.IV-1*.

Discussion. — Scholz (1979, pp. 63 and 66—68) pointed out that *Puzosia subplanulata* (Schlüter) is a junior synonym of *P. planulata* (J. de C. Sowerby) and followed Wiedmann & Dieni (1968, p. 110) in considering *P. mayoriana* (d'Orbigny) also as a junior synonym of the latter species. Furthermore, he included to the synonymy of *P. planulata* several poorly preserved and diagnosed forms recognized previously for varieties or even distinct species. It is notable that this was also the opinion of Passendorfer (1930, pp. 632—636) who recognized various morphotypes within *P. planulata* for being of *varietas* rank. The present author agrees

Table 10

Specimen No.	D mm	Wh %	U %	Constrictions per whorl
59.7757-1	17.5	46	29	4
60	25.0	45	30	7
46.7757-1/1	27.3	39	33	4 - 5
212.IV-1	31.0	41	31	5
57	34.6	42	31	5
61.073	39.1	41	34	5
216.IV-1	42.2	41	35	5
51.7761-1	45.0	39	35	5
52.9107-1	61.5	40	35	4 - 5
56.7756-3	72.6	41	32	ca 5
58.7811a	80.5	41	33	5
53.77	81.0	42	32	6

with Scholz (1979) that the species under discussion shows a considerable intraspecific variability and a wide stratigraphic range (Middle Albian to Cenomanian).

Remarks. — The specimen No. *60* shows much more constrictions than other approximately equal-sized ones (*cf.* biometry) which makes it similar to the morphotype *Puzosia octosulcata* (Sharpe). However, Pervinquière (1907, p. 157) demonstrated that there is a considerable variation in number of constrictions in *P. planulata* (J. de C. Sowerby), and the present author agrees with Scholz (1979) in considering this variation as falling within the range of intraspecific variability. The investigated specimens show more or less constant shell proportions (*cf.* biometry) but vary in ornamentation. Some individuals are finely ribbed (Pl. 6, Figs 1—7), while others display more prominent ribs at equal shell diameters (Pl. 6, Figs 8—11). This variation is unrelated to the stratigraphic position, as it is evidenced by the co-occurrence of the two morphotypes in a single bed (*e.g.* the specimens presented in Pl. 6, Figs 3—4, 6 and 10). The specimen No. *214.IV-1* (Pl. 6, Fig. 11) is a strongly ribbed mature body chamber, as indicated by its aperture provided with a wide, weakly projected ventral lappet and a single couple of lateral lappets. It is to be noted that there are specimens of *P. planulata* much larger-sized than the latter one, with densely spaced, fine ribs at the upper part and venter of whorls, persistent throughout the ontogeny (*cf.* Popovici-Hatzeg 1899, Pl. 2, Fig. 2; Naidin & Shimanskij 1959, Pl. 8, Fig. 1; Collignon 1963, Pl. 264, Fig. 1152).

The above discussed data demonstrate that, contrary to the opinion of Scholz (1979, p. 66), there is a variation in mature shell size in *P. planulata*. This variation in mature shell size and ornamentation can be most plausibly interpreted as a sexual dimorphism (*cf.* Makowski 1962a, b), with the strongly ribbed specimens (Pl. 6, Figs 8—11) being the microconchs, and the finely ribbed ones being, at least in part (Pl. 6, Figs 4—6, ?7), inner whorls of the macroconchs. Some specimens (Pl. 6, Figs 1—3) are juveniles that cannot be recognized for representative of one or the other morphotype.

Occurrence. — Lower to Middle Cenomanian, southwestern Crimea Highland (*cf.* Text-figs 5—6); Nos *137.82a, 143.82a, 144.82a*: Middle Cenomanian (along with *Acanthoceras rhotomagense* cf. *subflexuosum* Spath), Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

Southwestern Crimea Highland: Lower Cenomanian of the MGU Station, southern slope of the Mt. Selbukhra, Mender ravine, and Mt. Kremennaya: Nos *46.7757-1/1, 47.7757-1/2, 48.7757-1/3, 50.7757-1/4, 51.7751-1, 52.9107-1, 55.7757-1, 59.7757-1, 62.7759-2, 63.7759-2, 64.7757-1, 65.7757-1, 66.7757-1*: Band *IV-1* (Bed *1*); Nos *212—217.IV-1*: Band *IV-1*. Middle Cenomanian of the MGU Station, southern slope of the Mt. Selbukhra, and Mender ravine: Nos *67.7755-6, 68.7755-6:* Band *IV-2* (Bed *4*); No. *56.7756-3*: Band *IV-2* (Bed *5*). Lower or Middle Cenomanian of the Mt. Kremennaya, southern slope of the Mt. Selbukhra, Katscha river, and possibly other localities: Nos *49.6008-9a, 53.7', 54.7536-2, 57, 58.7811a, 60, 60a, 61.073.* As demonstrated by Naidin & Alekseev (1980), the species under discussion occurs also in the Bands *I—III* in the Southwestern Crimea Highland.

The species *Puzosia (P.) planulata* (J. de C. Sowerby) shows a world-wide distribution, having been recorded in the Middle Albian to Cenomanian of France, England, Italy, Switzerland, Austria, GFR, GDR, Poland, Hungary, Rumania, Bulgaria, the Soviet Union (the Podolia, Crimea, Caucasus, Georgia, and Kopet-Dag), Asia (Iran, southern India, Japan), Africa (Tunisia, Algeria, Moçambique, the Zululand, Angola) and Madagascar, and possibly North America.

Subgenus *AUSTINICERAS* Spath, 1922
(Type species: *Ammonites austeni* Sharpe, 1855)

Occurrence. — The subgenus *Austiniceras* Spath occurs in the Cenomanian to Turonian (possibly also the Albian and Campanian) of northwestern and southeastern Europe, Africa and Madagascar, Asia (Kopet-Dag, Iran, southern India, Japan), and North America.

Puzosia (Austiniceras) austeni (Sharpe, 1855)
(Pl. 6, Fig. 12)

1855. *Ammonites Austeni*, Sharpe; Sharpe [*partim*], pp. 28—29, Pl. 12, Fig. 1 [non Fig. 2= =*Puzosia (Anapuzosia) dibleyi* Spath].
1951. *Austiniceras austeni* (Sharpe); Wright & Wright, p. 19.
1971. *Austiniceras austeni* (Sharpe); Kennedy, pp. 38—39, Pl. 11, Fig. 1, and Pl. 12, Fig. 1.
1976. *Austiniceras austeni* (Sharpe); Juignet & Kennedy, pp. 72—73.

Material: Diagenetically flattened whorl fragments, Nos *209.7757-1* (Pl. 6, Fig. 12), *210.7757-2* and *218*.

Remarks. — The specimen No. *209.7757-1* (Pl. 6, Fig. 12) is a phragmocone fragment, as indicated by partly preserved sutural lines, with widely spaced major ribs starting at the umbilicus, supplemented with many intercalar ones arising at the mid-flank. This ornamentation is almost indistinguishable from that at the inner part of final whorl in the lectotype of *Puzosia (Austiniceras) austeni (Sharpe)* as illustrated by Kennedy (1971, Pl. 11, Fig. 1). A similar ornamentation is also shown by the specimen No. *210.7757-2*. In turn, the specimen No. *218*, which is a fragment of a much larger-sized whorl, shows more densely spaced major ribs, with intercalar ribs present only at the whorl venter and ventral part of the flank. These characteristics indicate that the latter specimen is a fragment of mature body chamber (*cf.* Kennedy 1971, p. 38, Pl. 11, Fig. 1).

Occurrence. — Nos *209.7757-1, 210.7757-2*: Lower Cenomanian, MGU Station, Band *IV-1* (Bed *1*), Crimea (*cf.* Text-fig. 6); No. *218*: Lower Cenomanian, marls at the right border of Bodrak river at Trudolubovka, Crimea (*cf.* Text-fig. 5*a*).

The species *Puzosia (Austiniceras) austeni* (Sharpe) has been reported from the Cenomanian to Turonian of England and France, and possibly from the Middle Cenomanian of Kopet-Dag (the Soviet Union).

Family **Hoplitidae** Douvillé, 1890
Subfamily **Hoplitinae** Douvillé, 1890
Genus *HYPHOPLITES* Spath, 1922
(Type species: *Ammonites falcatus* Mantell, 1822)

Remarks. — The genus *Hyphoplites* Spath is represented in the investigated collection by some tens of very well preserved phragmocones, the majority of which were collected in the Sullu-kapy section, Mangyshlak (cf. Pls 7—8). The investigated specimens are indicative of a considerable intraspecific variability, as well as of morphological intergradations among thus far recognized species (*see* below). This is caused by the common absence of any distinct morphological gap between thus far recognized species and subspecies (*cf.* Wright & Wright 1949) of *Hyphoplites*. Unfortunately, body chambers are lacking in the investigated specimens and hence, the present author is unable to undertake a revision of the genus. Therefore, the traditional taxonomy (Wright & Wright 1949) of the genus *Hyphoplites* is followed in the present paper, in spite of its arbitrariness.

Occurrence. — The genus *Hyphoplites* Spath shows a Boreal distribution, having been reported from the uppermost Albian to Lower Cenomanian of West Europe to the Transcaspia and Iran (Seyed-Emami & *al.* 1971, Kennedy & *al.* 1979) and Turkmenia (Atabekyan 1961, Manija 1974). Southwards, the genus occurs rather commonly in the uppermost Albian to Lower Cenomanian of the Swiss Jura Mts (*cf.* Renz & *al.* 1963; Renz 1968), infrequently in the Lower Cenomanian of southern France, and sporadically in the Lower Cenomanian of Israel (Avnimélech 1965).

Hyphoplites falcatus falcatus (Mantell, 1822)
(Pl. 7, Figs 1—3)

1822. *Ammonites falcatus;* Mantell, pp. 117—118, Pl. 21, Figs 6, 12.
1853. *Ammonites falcatus,* Mantell; Sharpe [*partim*], p. 21, Pl. 7, Fig. 7.
1871. *Ammonites falcatus,* Mant.; Schlüter [*partim*], pp. 14—15, Pl. 6, Figs 3—4.
1899. *Hoplites falcatus* Mant.; Semenov, pp. 129—130, Pl. 5, Fig. 4.
1949. *Hyphoplites falcatus falcatus* (Mantell); Wright & Wright, pp. 484—485, Pl. 30, Figs 1 and 3—4.
1951. *Hyphoplites falcatus* (Mantell); Wright & Wright, p. 21.
1959. *Hyphoplites falcatus* (Mantell); Cieśliński, pp. 53—54.
1959. *Hyphoplites falcatus falcatus* (Mantell); Hancock, p. 249.
1961. *Hyphoplites falcatus* (Mantell); Pasternak, p. 21, Pl. 1, Fig. 17.
1963. *Hyphoplites falcatus falcatus* (Mantell); Renz, p. 1096.
1965. *Hyphoplites falcatus* (Mantell); Avnimélech, pp. 160—162, Text-fig. 1.
1971. *Hyphoplites falcatus falcatus* (Mantell); Kennedy, pp. 41—42, Pl. 15, Fig. 2.
1974. *Hyphoplites falcatus falcatus* (Mant.); Manija, p. 95.
1976. *Hyphoplites falcatus falcatus* (Mantell); Juignet & Kennedy, p. 73, Pl. 6, Fig. 6.
1976. *Hyphoplites falcatus falcatus* (Mantell); Kennedy & Hancock, p. 37, Pl. 6, Fig. 3.
1977. *Hyphoplites falcatus falcatus* (Mantell); Juignet, p. 146.
1978. *Hyphoplites falcatus falcatus* (Mantell); Amedro, p. 7.
1978. *Hyphoplites falcatus falcatus* (Mantell); Juignet, Kennedy & Lebert, pp. 92 and 94—95.
1979. *H. (Hyphoplites) falcatus* (Mantell); Wiedmann & Schneider, pp. 661—662, Pl. 5, Fig. 5.

Material: A dozen specimens, Nos. *I.H.13a* (Pl. 7, Fig. 1), *I.H.14a* (Pl. 7, Fig. 2), *I.H.14b* (Pl. 7, Fig. 3), *I.H.13b, I.H.13c, I.H.13d, I.H.14c, I.H.14d, I.H.14e, I.H.14f, I.H.14g* and *Tr 69*.

Remarks. — The specimen No. *I.H.13a* (Pl. 7, Fig. 1) is almost indistinguishable in ornamentation from the inner whorls of that one illustrated by Wright & Wright (1949, Pl. 30, Fig. 3), and the occurrence of flattened, sickle-shaped ribs and fairly distinct, ventral clavi indicates that this is a form typical of the subspecies. In turn, the specimen No. *I.H.14a* (Pl. 7, Fig. 2) shows a more conspicuous ribbing at a shell diameter approximating that in the former specimen, which makes it close to another form described and illustrated by Wright & Wright (1949, p. 485, Pl. 30, Fig. 1).

Occurrence. — No. *Tr 69:* Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Tex-fig. 2); all the other specimens: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text--fig. 12).

The subspecies *Hyphoplites falcatus falcatus* (Mantell) has been recorded in the Lower Cenomanian of England, France, Switzerland, GFR, GDR, the Soviet Union (Transcarpathian and Transcaspian regions, Kopet-Dag), and Israel.

Hyphoplites falcatus aurora Wright & Wright, 1949 (Pl. 7, Figs 4—5)

1858—1860. *Ammonites falcatus*, Mantell; Pictet & Campiche [*partim*], pp. 210—211, Pl. 27, Fig. 6.
1949. *Hyphoplites falcatus* (Mantell) subsp. chron. *aurora* nov.; Wright & Wright, pp. 485—486, Pl. 29, Figs 3, 9, and Pl. 30, Fig. 5.
1951. *Hyphoplites falcatus aurora* Wright & Wright; Wright & Wright, p. 21.
1968. *Hyphoplites falcatus aurora* C. W. et E. V. Wright; Renz, p. 26, Text-fig. 9d, Pl. 2, Fig. 15.
1968. *Hyphoplites falcatus* aff. *aurora* C. W. et E. V. Wright; Renz, pp. 26—27, Text-fig. 8e-h, Pl. 2, Figs 9, 11, and 19.
1971. *Hyphoplites falcatus aurora* Wright and Wright; Kennedy, p. 42.
?1972. *Hyphoplites* aff. *campichei* Spath transitional to *falcatus aurora* Wright and Wright; Hancock, Kennedy & Klaumann, p. 446, Pl. 81, Fig. 2.
1974. *Hyphoplites falcatus aurora* Wr. et Wr.; Manija, p. 95.
1974. *Hyphoplites falcatus aurora* Wright & Wright; Marcinowski, pp. 173—174, Pl. 33, Fig. 2.
1977. *Hyphoplites falcatus aurora* Wright and Wright; Juignet, p. 146.
1978. *Hyphoplites falcatus aurora* Wright et Wright; Juignet, Kennedy & Lebert, pp. 92 and 94—95.

Material: Two specimens, Nos *I.H.15a* (Pl. 7, Fig. 4) and *I.H.15b* (Pl. 7, Fig. 5).

Remarks. — The investigated specimens show almost exclusively dichotomous ribs, and their ventro-lateral (peripheral) clavi are sharper but less prominent than in *Hyphoplites falcatus falcatus* (Mantell) (*cf.* Pl. 7, Figs 4c, 5c and 1c, 2c), which characteristics are diagnostic of the subspecies *aurora* of Wright & Wright (1949, p. 485).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12).

The subspecies *Hyphoplites falcatus aurora* Wright & Wright has been recorded in the uppermost Albian to Lower Cenomanian of England, the uppermost Albian of Switzerland, and the Lower Cenomanian of France, Poland, the Soviet Union (Kopet-Dag), and possibly GFR.

Hyphoplites falcatus interpolatus Wright & Wright, 1949 (Pl. 7, Figs 6—7)

1858—1860. *Ammonites falcatus*, Mantell; Pictet & Campiche [*partim*], pp. 210—211, Pl. 27, Fig. 8.
1949. *Hyphoplites falcatus* (Mantell) var. *interpolatus* nov.; Wright & Wright, p. 485, Pl. 30, Figs 2 and 6—7.
1951. *Hyphoplites falcatus* var. *interpolatus* Wright & Wright; Wright & Wright, p. 21.
1959. *Hyphoplites falcatus* (Mantell) var. *interpolatus* Wright & Wright; Hancock, p. 249.

1959. *Hyphoplites falcatus* Mant.; Aliev & Aliev [*partim*], pp. 213—214, Pl. 1, Fig. 1.
1963. *Hyphoplites falcatus interpolatus* Wright & Wright; Renz, p. 1096, Pl. 1, Fig. 11.
1968. *Hyphoplites falcatus* aff. *interpolatus* C. W. et E. V. Wright; Renz, p. 27, Pl. 2, Fig. 14.
1971. *Hyphoplites falcatus interpolatus* Wright and Wright; Kennedy, p. 42.
1974. *Hyphoplites falcatus interpolatus* Wr. et Wr.; Manija, p. 95.
1976. *Hyphoplites falcatus interpolatus* Wright et Wright; Juignet & Kennedy, p. 74, Pl. 6. Figs 10—11.
1977. *Hyphoplites falcatus interpolatus* Wright and Wright; Juignet, p. 145.
1978. *Hyphoplites falcatus interpolatus* Wright et Wright; Juignet, Kennedy & Lebert, pp. 92 and 94.

Material: Two specimens, Nos *I.H.16a* (Pl. 7, Fig. 6) and *I.H.16b* (Pl. 7, Fig. 7).

Remarks. — The investigated specimens show traces after lower ventro-lateral tubercles, and rather widely spaced umbilical bullae, which characteristics make them close to *Hyphoplites curvatus* (Mantell). However, they display mostly double, sparcely tripple-split ribs, that join together at the top; while such a ribbing is diagnostic of the subspecies *interpolatus* of Wright & Wright (1949, p. 485).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

The subspecies *Hyphoplites falcatus interpolatus* Wright & Wright has been reported from the uppermost Albian to Lower Cenomanian of Switzerland, and the Lower Cenomanian of England, France, and the Soviet Union (Kopet-Dag).

Hyphoplites campichei campichei Spath, 1925
(Pl. 7, Figs 8—11)

1858—1860. *Ammonites falcatus*, Mantell; Pictet & Campiche [*partim*], pp. 210—211, Pl. 27, Fig. 1.
1974. *Hyphoplites campichei campichei* Spath, 1925; Marcinowski, p. 173, Pl. 33, Fig. 1 [*cum syn.*].

Material: A dozen specimens, Nos *I.H.17a* (Pl. 7, Fig. 8), *I.H.17b* (Pl. 7, Fig. 9), *I.H.18b* (Pl. 7, Fig. 10), *I.H.18a* (Pl. 7, Fig. 11), *I.H.17c, I.H.17d, I.H.17e, I.H.17f, I.H.17g, I.H.18c, I.H.18d, I.H.18e, I.H.18f,* and *I.H.18g.*

Remarks. — The specimens Nos *I.H.17a, I.H.17b,* and *I.H.18a* (Pl. 7, Figs 8—9 and 11) present forms typical of the subspecies. The specimen No. *I.H.18b* (Pl. 7, Fig. 10) shows longer and stronger ribs making the ventro-lateral margin more crenulate, which characteristics result in an affinity to *Hyphoplites falcatus* (Mantell).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

The subspecies *Hyphoplites campichei campichei* Spath has been reported from the uppermost Albian of Switzerland, the uppermost Albian to Lower Cenomanian of England, and the Lower Cenomanian of France, Poland, and the Soviet Union (Transcapia, Kopet-Dag).

Hyphoplites campichei densecostatus Renz, 1968
(Pl. 7, Fig. 12)

1949. *Hyphoplites campichei* Spath, form transitional between *Discohoplites subfalcatus* (Semenow) and *Hyphoplites campichei* Spath; Wright & Wright, pp. 479 and 483, Pl. 29, Fig. 1.
1968. *Hyphoplites campichei densecostatus* n. ssp.; Renz, pp. 25—26, Text-figs 9b, e and 10b, Pl. 2, Figs 8, 10.

1979. *Hyphoplites (Discohoplites) coelonotus densecostatus* (Renz, 1968); Scholz, pp. 73—74, Pl. 13, Figs 3—4 and 12.

Material: One specimen, No. *I.H.19* (Pl. 7, Fig. 12).

Remarks. — There are 2—3 or even 4 very fine ribs between indistinct major ribs in the upper part of whorls; actually, these are incisions of the ventro-lateral margin which give it up a very finely crenulate appearance. This crenulation of the ventro-lateral margin and a densely spaced, fine ribbing make up a difference between the subspecies *densecostatus* of Renz (1968, p. 26) and the nominative subspecies (*cf*. Pl. 7, Figs 12 and 8—11, respectively).

Juignet & Kennedy (1976, p. 74) do not accept the subspecies under discussion, even though they do accept various subspecies of *Hyphoplites falcatus* (Mantell). The present author is of the opinion that morphological differences are of equal significance in both the cases and therefore, follows Renz (1968) in recognizing the forms referred to in the synonymy for a distinct subspecies.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf*. Text-fig. 12).

The subspecies *Hyphoplites campichei densecostatus* Renz has been reported from the uppermost Albian of England, Switzerland, and Hungary.

Hyphoplites pseudofalcatus (Semenov, 1899) (Pl. 7, Figs 13—16, Pl. 8, Fig. 1)

1840—1841. *Ammonites falcatus*, Mantell; d'Orbigny [*partim*], pp. 331 and 333, Pl. 99, Figs 2—3.
1853. *Ammonites falcatus*, Mantell; Sharpe [*partim*], pp. 21—22, Pl. 7, Fig. 5.
1899. *Hoplites pseudofalcatus*; Semenov, pp. 129—130.
1949. *Hyphoplites pseudofalcatus* (Semenow); Wright & Wright, pp. 486—487, Pl. 31, Figs 5—9.
1951. *Hyphoplites pseudofalcatus* (Semenow); Wright & Wright, p. 21.
1959. *Hyphoplites pseudofalcatus* (Semenow); Hancock, p. 249.
1961. *Hyphoplites pseudofalcatus* Semen.; Atabekyan, p. 63.
1966. *Hyphoplites pseudofalcatus* Sem.; Sokolov, p. 59.
1971. *Hyphoplites pseudofalcatus* (Semenow); Kennedy, p. 44.
1974. *Hyphoplites pseudofalcatus* (Sem.); Manija, p. 95.
1977. *Hyphoplites pseudofalcatus* (Semenow); Juignet, pp. 145—146.
1978. *Hyphoplites pseudofalcatus* (Semenow); Juignet, Kennedy & Lebert, pp. 92 and 95.

Material: A dozen specimens, Nos *I.H.20* (Pl. 7, Fig. 13), *I.H.10b* (Pl. 7, Fig. 14), *I.H.10a* (Pl. 7, Fig. 15), *I.H.11b* (Pl. 7, Fig. 16), *I.H.11a* (Pl. 8, Fig. 1), *I.H.10c*, *I.H.10d*, *I.H.11c*, *I.H.11d*, *I.H.11e*, *I.H.11f*, *I.H.11g*, and *I.H.11h*.

Remarks. — The investigated material allows to recognize the intraspecific variability within *Hyphoplites pseudofalcatus* (Semenov). It includes rather finely ribbed forms, with distinct ventral clavi that appear at a fairly large shell diameter (*cf*. Pl. 7, Figs 13—15), resembling those illustrated by Wright & Wright (1949, Pl. 31, Figs 6 and 9). On the other hand, the material includes also specimens with more conspicuous ribs and tubercles, and every second rib being finer than the remaining ones (*cf*. Pl. 7, Fig. 16 and Pl. 8, Fig. 1). The latter morphotype, and especially the specimen No. *I.H.11a* (Pl. 8, Fig. 1) showing fairly distinct lower ventro-lateral tubercles at a greater diameter, is transitional to *Hyphoplites curvatus* (Mantell) as described and illustrated by Wright & Wright (1949, pp. 486—487, Pl. 31, Figs 5 and 7—8). In turn, the specimen No. *I.H.20* (Pl. 7, Fig. 13) shows densely spaced ribs, relatively narrow whorls, and poorly developed peripheral clavi, which characteristics make it close to *Hyphoplites costosus* Wright & Wright.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf*. Text-fig. 12).

The species *Hyphoplites pseudofalcatus* (Semenov) has been recorded in the Lower Cenomanian of England, France, the Soviet Union (Transcaspia and Kopet--Dag), and Iran.

Hyphoplites pylorus Wright & Wright, 1949
(Pl. 8, Fig. 2)

1858—1860. *Ammonites curvatus*, Mantell; Pictet & Campiche [*partim*], pp. 212—213, Pl. 27, Figs 10 and 12.
1949. *Hyphoplites pylorus* sp. nov.; Wright & Wright, p. 488, Pl. 29, Fig. 2.
1966. *Hyphoplites pylorus* C. W. et E. V. Wright; Sokolov, p. 58.
1968. *Hyphoplites pylorus pylorus* C. W. et E. V. Wright; Renz, p. 28, Text-fig. 9g, Pl. 2, Figs 16—17.
?1968. *Hyphoplites pylorus planicostatus* n. ssp.; Renz, p. 28, Text-fig. 9f, Pl. 2, Fig. 18.

Material: One specimen, No. *I.H.6.*

Remarks. — The investigated specimen presents only the innermost part of phragmocone but nevertheless, its whorls being square in cross section, with singular falcate ribs, prominent lower and upper ventro-lateral tubercles, and a wide and very distinct siphonal furrow are indicative of its assignment to *Hyphoplites pylorus* Wright & Wright, while they make a difference from the related species *H. curvatus* (Mantell) (*cf.* Pl. 8, Figs 2 and 4, respectively).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12).

The species *Hyphoplites pylorus* Wright & Wright has been reported from the uppermost Albian of England and Switzerland, and the Lower Cenomanian of the Soviet Union (Mangyshlak).

Hyphoplites curvatus (Mantell, 1822)
(Pl. 8, Figs 3—4)

1822. *Ammonites curvatus*; Mantell p. 118, Pl. 21, Fig. 18.
1949. *Hyphoplites curvatus* (Mantell); Wright & Wright, pp. 488—490, Pl. 31, Figs 1—4 [*cum syn.*].
1951. *Hyphoplites curvatus* (Mantell); Wright & Wright, p. 21.
1959. *Hyphoplites curvatus* (Mantell); Hancock, p. 249.
1961. *Hyphoplites curvatus* Mant.; Atabekyan, p. 63.
1966. *Hyphoplites curvatus* Mant.; Sokolov, p. 58.
1969. *Hyphoplites curvatus*; Kennedy, p. 546, Pl. 15, Fig. 5.
1971. *Hyphoplites curvatus* (Mantell); Kennedy, p. 43, Pl. 15, Figs 1 and 3.
1974. *Hyphoplites curvatus* (Mant.); Manija, p. 66.
1976. *Hyphoplites curvatus* (Mantell); Juignet & Kennedy, p. 75, Pl. 6, Figs 12 and 14—15.
1976. *Hyphoplites curvatus* (Mantell); Kennedy & Hancock, p. 37, Pl. 6, Fig. 4.
1977. *Hyphoplites curvatus* (Mantell); Juignet, p. 163.
1978. *Hyphoplites curvatus* (Mantell); Juignet, Kennedy & Lebert, pp. 92 and 95.
1979. *Hyphoplites curvatus* (Mantell); Kennedy, Chahida & Djafarian, pp. 26—27, Pl. 2, Figs 1 and 9.
1979. *H. (Hyphoplites) curvatus* (Mantell); Wiedmann & Schneider, p. 662, Pl. 5, Fig. 4.

Material: Four specimens, Nos *I.H.5a* (Pl. 8, Fig. 3), *I.H.5b* (Pl. 8, Fig. 4), *I.H.5c*, and *79.9200*.

Remarks. — The specimen No. *I.H.5a* (Pl. 8, Fig. 3) shows poorly developed lower ventro-lateral tubercles which results in its resemblance to *Hyphoplites falcatus interpolatus* Wright & Wright, as well as in its ornamentation being like in twice greater representatives of the species *curvatus* Mantell (*cf.* Wright & Wright 1949, Pl. 31, Fig. 2).

The specimen No. *I.H.5b* (Pl. 8, Fig. 4) presents a more inner part of phragmocone, with singular ribs linking prominent lower and upper ventro-lateral tubercles, which feature is typical of the species *H. pylorus* Wright & Wright, supplemented later in ontogeny with bi- or tripartite umbilical ribs diagnostic of *H. curvatus* (Mantell). Other differences between the two species are enumerated in remarks on the former species.

Occurrence. — Nos *I.H.5a*, *I.H.5b*, *I.H.5c*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); No. *72.9200*: Lower Cenomanian, Mt. Kremennaya, Crimea (*cf.* Text-figs 5a, 6).

The species *Hyphoplites curvatus* (Mantell) has been reported from the Lower Cenomanian of England, France, Switzerland, GFR and GDR, the Soviet Union (Transcaspia and Kopet-Dag), and Iran.

Hyphoplites crassofalcatus crassofalcatus (Semenov, 1899) (Pl. 8, Figs 5—9 and 15)

1853. *Ammonites falcatus*, Mantell; Sharpe [*partim*], pp. 21—22, Pl. 7, Fig. 8.
1857. *Ammonites curvatus*, Mantell; Sharpe, pp. 49—50, Pl. 23, Fig. 1.
1899. *Hoplites crassofalcatus*; Semenov, pp. 129—130.
1949. *Hyphoplites crassofalcatus* (Semenow); Wright & Wright, p. 490, Pl. 32, Figs 5—6 and 8 [Fig. 1 presents a specimen transitional to *H. arausionensis* (Hébert & Munier-Chalmas).
1951. *Hyphoplites crassofalcatus* (Semenow); Wright & Wright, p. 21.
1959. *Hyphoplites crassofalcatus* (Semenow); Hancock, p. 249.
1961. *Hyphoplites crassofalcatus* Semen.; Atabekyan, p. 68.
1966. *Hyphoplites crassofalcatus* Sem.; Sokolov, p. 58.
1971. *Hyphoplites arausionensis arausionensis* (Hébert and Munier-Chalmas); Kennedy [*partim*], p. 43.
1974. *Hyphoplites crassofalcatus* (Sem.); Manija, p. 95.
1976. *Hyphoplites arausionensis arausionensis* (Hébert et Munier-Chalmas); Juignet & Kennedy [*partim*], p. 76.
1977. *Hyphoplites arausionensis arausionensis* Hébert and Munier-Chalmas; Juignet [*partim*], p. 146.
1978. *Hyphoplites arausionensis arausionensis* Hébert et Munier-Chalmas; Juignet, Kennedy & Lebert [*partim*], pp. 92 and 94—95.
?1979. *Hyphoplites arausionensis horridus* Wright and Wright, 1949; Kennedy, Chahida & Djafarian, pp. 27—28, Pl. 2, Fig. 10.

Material: Seven specimens, Nos *I.H.4a* (Pl. 8, Fig. 5), *I.H.4b* (Pl. 8, Fig. 6), *I.H.2a* (Pl. 8, Fig. 7), *I.H.2b* (Pl. 8, Fig. 8), *I.H.3a* (Pl. 8, Fig. 9), *I.H.7* (Pl. 8, Fig. 15), *I.H.2c*, and *I.H.3b*.

Remarks. — The specimens Nos *I.H.4a* and *I.H.4b* (Pl. 8, Figs 5—6) are non-ribbed, but with very prominent, longitudinally flattened umbilical tubercles with two lower tubercles in form of rudimentary ribs inbetween, and distinct, clavate lower and upper ventro-lateral tubercles. They present a form typical of the subspecies.

The specimens Nos *I.H.2a* and *I.H.2b* (Pl. 8, Figs 7—8) resemble *Hyphoplites crassofalcatus horridus* Wright & Wright in their more prominent umbilical tubercles, but they differ from the latter subspecies in their much narrower whorls and smaller tubercles.

The specimen No. *I.H.3a* (Pl. 8, Fig. 9) displays main umbilical tubercles as prominent as they are in *H. crassofalcatus horridus*, but the occurrence of two rudimentary tubercles between each two main umbilical ones, and somewhat narrower whorls make it transitional between *H. crassofalcatus crassofalcatus* and *H. crassofalcatus horridus*.

The specimen attributed by Kennedy & *al.* (1979, Pl. 2, Fig. 10) to *H. crassofalcatus horridus* shows a little narrower whorls and less prominent tubercles than typical forms of that subspecies do (*cf.* Wright & Wright 1949, Pl. 32, Fig. 7), and may be more close to *H. crassofalcatus crassofalcatus* than to the other subspecies.

Discussion. — Kennedy (1971), Juignet & Kennedy (1976) and Kennedy & *al.* (1979) included *Hyphoplites crassofalcatus* (Semenov) to the synonymy of *H. arausionensis* (Hébert & Munier-Chalmas) because, in their opinion, the specimen recognized by Wright & Wright (1949, p. 491) for the lectotype of the latter species „is clearly not separable from *Hyphoplites crassofalcatus*" (Kennedy 1971, p. 43).

In turn, Wright & Wright (1949, p. 491) emphasized a close relationship between these two species but nevertheless, recognized them for being distinct and wrote, „*Hyphoplites arausionensis* (Hébert & Munier-Chalmas) is really a compressed form of *H. crassofalcatus* (Semenow) with stronger ribs and reduced tubercles". These differences appear at various ontogenetic stages [*cf. H. arausionensis* as illustrated by Wright & Wright (1949, Pl. 32, Figs 2—3), Kennedy (1971, Pl. 15, Fig. 4), and Kennedy & *al.* (1979, Pl. 2, Figs 2, 8) with *H. crassofalcatus* as figured by Wright & Wright (1949, Pl. 32, Figs 5—6 and 8)]. They are evident also in the investigated material collected from a single locality (*cf.* Pl. 8, Figs 5—9 and 12—13). There are forms transitional between the two species under discussion (*cf.* Wright & Wright 1949, Pl. 32, Fig. 1; Juignet & Kennedy 1976, Pl. 6, Fig. 11) but this is the case also with other, thus far widely accepted species of the genus *Hyphoplites* Spath.

Therefore, the present author applies the morphological species limits set by Wright & Wright (1949), and makes a distinction between the species *H. crassofalcatus* and *H. arausionensis*.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

The subspecies *Hyphoplites crassofalcatus crassofalcatus* (Semenov) has been recorded in the Lower Cenomanian of England, France, the Soviet Union (Transcaspia, Kopet-Dag), and possibly Iran.

Hyphoplites crassofalcatus horridus Wright & Wright, 1949 (Pl. 8, Figs 10—11)

1949. *Hyphoplites crassofalcatus* (Semenow) var. *horridus* nov.; Wright & Wright, p. 491, Pl. 31, Fig. 10, Pl. 32, Fig. 7.
1951. *Hyphoplites crassofalcatus* var. *horridus* Wright & Wright; Wright & Wright, p. 21.
1966. *Hyphoplites horridus* C. W. et E. V. Wright; Sokolov, p. 58.
1971. *Hyphoplites arausionensis horridus* Wright and Wright; Kennedy, p. 43.
1974. *Hyphoplites crassofalcatus horridus* Wr. et Wr.; Manija, p. 95.
1976. *Hyphoplites arausionensis horridus* Wright et Wright; Juignet & Kennedy, p. 76.
1977. *Hyphoplites arausionensis horridus* Wright and Wright; Juignet, p. 145.
1978. *Hyphoplites arausionensis horridus* (Wright et Wright); Amedro, p. 7.
1978. *Hyphoplites arausionensis horridus* Wright et Wright; Juignet, Kennedy & Lebert, pp. 92 and 94.
1979. *Hyphoplites arausionensis horridus* Wright & Wright, 1949; Kennedy, Chahida & Djafarian [*partim*], pp. 27—28 [non Pl. 2, Fig. 10 = ?*H. crassofalcatus crassofalcatus*].

Material: Five specimens, Nos *I.H.1a* (Pl. 8, Fig. 10), *I.H.1b* (Pl. 8, Fig. 11), *I.H.1c*, *I.H.1d*, and *I.H.1e*.

Remarks. — The investigated specimens (Pl. 8, Figs 10—11) show broad whorls, very prominent and pointed umbilical tubercles, and a wide and distinct siphonal furrow, which characteristics are diagnostic of the subspecies *horridus* Wright & Wrgiht.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

The subspecies *Hyphoplites crassofalcatus horridus* Wright & Wright has been recorded in the Lower Cenomanian of England, France, and the Soviet Union (Transcaspia and Kopet-Dag).

Hyphoplites arausionensis (Hébert & Munier-Chalmas, 1875) (Pl. 8, Figs 12—13)

1875. *Ammonites arausionensis*, n. sp.; Hébert & Munier-Chalmas [*partim*], pp. 115—116, Pl. 4, Fig. 5.
1949. *Hyphoplites arausionensis* (Hébert and Munier-Chalmas); Wright & Wright, p. 491, Pl. 32, Figs 2—4.
1951. *Hyphoplites arausionensis* (Hébert & Munier-Chalmas); Wright & Wright, p. 21.
1971. *Hyphoplites arausionensis arausionensis* (Hébert and Munier-Chalmas); Kennedy [*partim*], p. 43, Pl. 15, Fig. 4.
1974. *Hyphoplites arausionensis* Heb. et Mun.-Chalm.; Manija, p. 95.
1976. *Hyphoplites arausionensis arausionensis* (Hébert et Munier-Chalmas); Juignet & Kennedy [*partim*], p. 75, Pl. 6, Figs ?8, 9, and 16 [Fig. 11 presents a specimen transitional between *H. crassofalcatus* and *H. arausionensis*].
1977. *Hyphoplites arausionensis arausionensis* Hébert and Munier-Chalmas; Juignet [*partim*], p. 146.
1978. *Hyphoplites arausionensis arausionensis* Hébert et Munier-Chalmas; Juignet, Kennedy & Lebert [*partim*], pp. 92 and 94—95.
1979. *Hyphoplites arausionensis arausionensis* (Hébert and Munier-Chalmas); Kennedy, Chahida & Djafarian [*partim*], p. 27, Pl. 2, Figs 2, ?8.

Material: Three specimens, Nos *I.H.8a* (Pl. 8, Fig. 12), *I.H.8b* (Pl. 8, Fig. 13) and *I.H.8c*.

Remarks. — The specimen No. *I.H.8a* (Pl. 8, Fig. 12) shows widely spaced, bifurcate and singular, flat, a little falcate ribs, compressed whorls, and reduced tubercles, which characteristics make it different from *Hyphoplites crassofalcatus crassofalcatus* (Semenov) (*cf.* Pl. 8, Figs 5—9). The other illustrated specimen shows even more reduced tubercles, which results in its preponderantly ribbed appearance (*cf.* Pl. 8, Fig. 13).

Kennedy (1971) and some other authors (*see* synonymy) propose to treat *H. arausionensis* (Hébert & Munier-Chalmas) much more widely, with *H. crassofalcatus* (Semenov) conceived of at its junior synonym. However, the present author is of the opinion that these are distinct species (*cf.* discussion on *H. crassofalcatus crassofalcatus*).

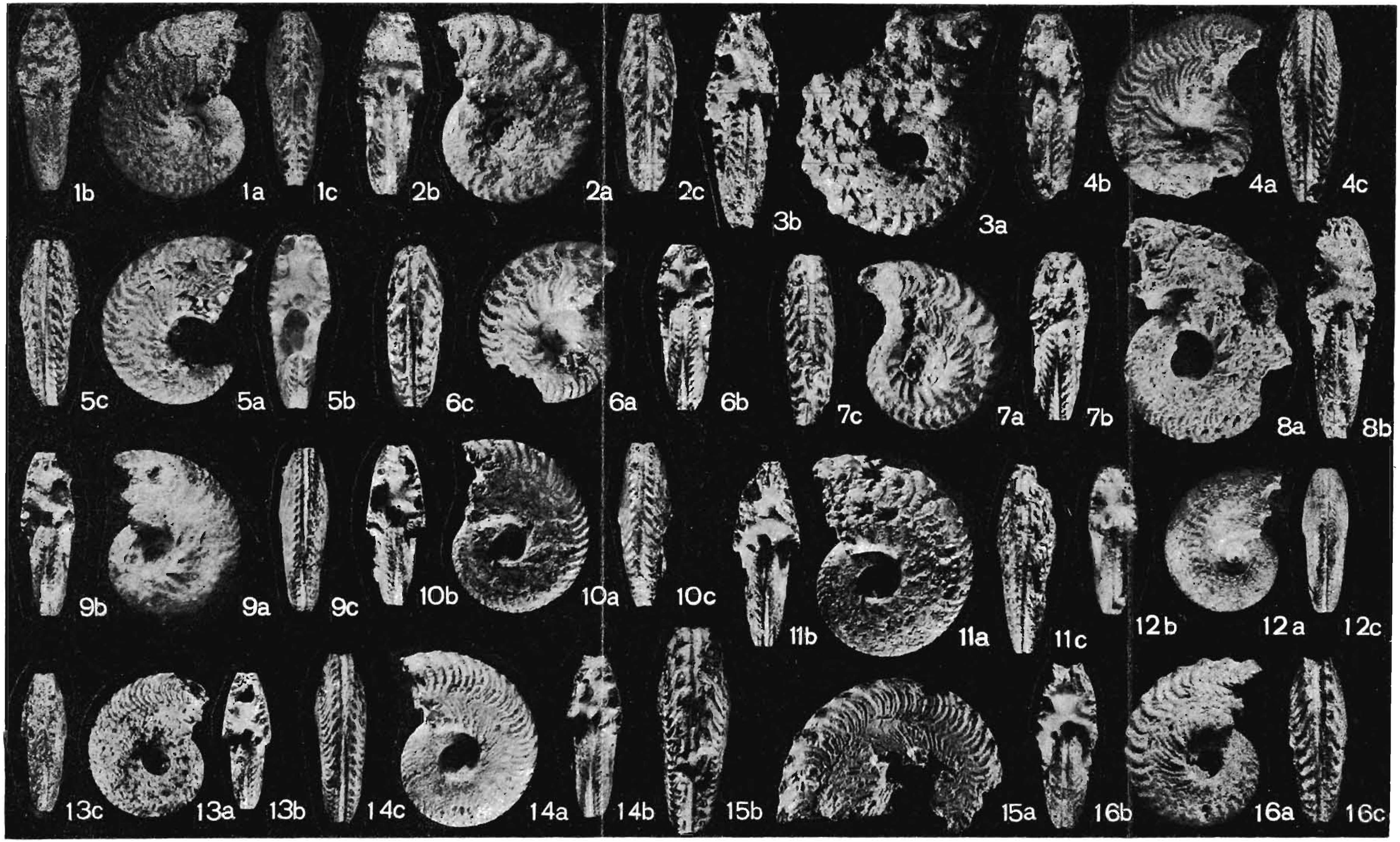
Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

The species *Hyphoplites arausionensis* (Hébert & Munier-Chalmas) has been reported from the Lower Cenomanian of England, France, and the Soviet Union (Kopet-Dag).

Hyphoplites sp. *A* (Pl. 8, Fig. 14)

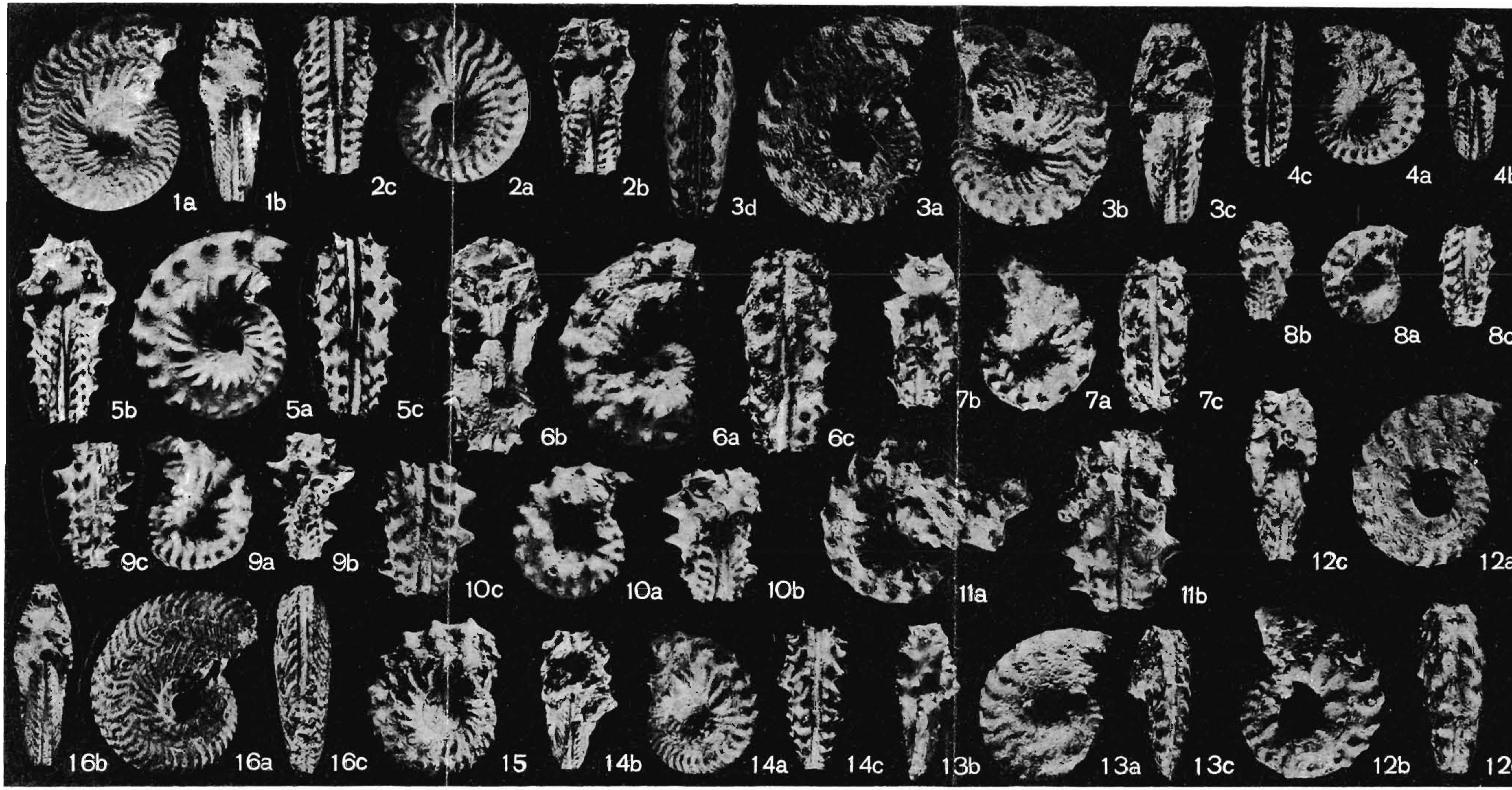
Material: One specimen, No. *I.H.9*.

Description. — The whorls are higher than broad, with flat flanks, and a distinct but narrow siphonal furrow. The inner whorls (less than 13.3 mm in diameter) are ornamented with singular, a little falcate ribs which start at the umbilical edge and end with a row of fine ventro-lateral tubercles (*cf.* Pl. 8, Fig. 14*a*-*b*). Here and there, an intercalar rib appears at the mid-flank, ended with a tubercle indistinguishable from the others. A similar pattern of shell ornamentation occurs



Representatives of the genus *Hyphoplites* Spath from the Lower Cenomanian in the Sullu-kapy section, Bands 3—4 (*I* faunal horizon), Mangyshlak; all figures are taken × 2

Hyphoplites falcatus falcatus (Mantell): **1** — specimen No. I.H.13a, **2** — No. I.H.14a, **3** — No. I.H.14b. **Hyphoplites falcatus aurora** Wright & Wright: **4** — specimen No. I.H.15a, **5** — No. I.H.15b. **Hyphoplites falcatus interpolatus** Wright & Wright: **6** — specimen No. I.H.16a, **7** — No. I.H.16b. **Hyphoplites campichei campichei** Spath: **8** — specimen No. I.H.17a, **9** — No. I.H.17b, **10** — No. I.H.18b, **11** — No. I.H.18a. **Hyphoplites campichei densecostatus** Renz: **12** — specimen No. I.H.19. **Hyphoplites pseudofalcatus** (Semenov): **13** — specimen No. I.H.20, **14** — No. I.H.10b, **15** — No. I.H.10a, **16** — No. I.H.11b



Representatives of the genus *Hyphoplites* Spath from the Lower Cenomanian in the Sullu-kapy section, Bands 3—4 (*I* faunal horizon), Mangyshlak; all figures are taken × 2, except Fig. 2 which is × 3

Hyphoplites pseudofalcatus (Semenov): 1 — specimen No. I.H.11a. **Hyphoplites pylorus** Wright & Wright: 2 — specimen No. I.H.6. **Hyphoplites curvatus** (Mantell): 3 — specimen No. I.H.5a, 4 — No. I.H.5b. **Hyphoplites crassofalc** crassofalcatus (Semenov): 5 — specimen No. I.H.4a, 6 — No. I.H.4b, 7 — No. I.H.2a, 8 — No. I.H.2b, 9 — No. I.H.3a. **Hyphoplites crassofalcatus horridus** Wright & Wright: 10 — specimen No. I.H.1a, 11 — No. I.H.1b. **Hyphop** **arausionensis** (Hébert & Munier-Chalmas): 12 — specimen No. I.H.8a, 13 — No. I.H.8b. **Hyphoplites** sp. A: 14 — specimen No. I.H.9. **Hyphoplites crassofalcatus crassofalcatus** (Semenov): 15 — specimen No. I.H.7. **Hyphoplites** 16 — specimen No. I.H.12, form transitional between *H. falcatus interpolatus* and *H. pseudofalcatus* in *Hyphoplites falcatus falcatus* (Mantell) and in the inner whorls of some individuals of *H. pseudofalcatus* (Semenov) (*cf.* Pl. 8, Fig. 1*a*).

The ornamentation rapidly changes at a shell diameter greater than 13.3 mm. The ribs disappear, replaced with very prominent umbilical tubercles and lower and upper ventro-lateral ones (*cf.* Pl. 8, Fig. 14*a*, *c*). There are two weakly developed, flattened tubercles in form of rudimentary ribs between each two main umbilical tubercles. This ornamentation resembles that in *H. crassofalcatus crassofalcatus* (Semenov) (*cf.* Pl. 8, Figs 5*c*, 9*c*).

Remarks. — The investigated specimens shows a dramatic change in ornamentation pattern, a feature unknown in other representatives of the genus *Hyphoplites Spath.* This moderately-sized phragmocone displays ornamentation type typical of *Hyphoplites falcatus* and, later in ontogeny, *H. crassofalcatus,* which species are conceived of as representative of distinct phylogenetic branches of the genus (*cf.* Wright & Wright 1949, p. 493, Text-fig. 1). The material is insufficient to permit recognition of the nature of this change in ornamentation, *i.e.* whether it is a feature recurrent also in other specimens and hence diagnostic of a new species, or merely a pathologic deformation.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

Hyphoplites sp. [transitional between *Hyphoplites falcatus interpolatus* and *Hyphoplites pseudofalcatus*] (Pl. 8, Fig. 16)

Material: One specimen, No. *I.H.12.*

Remarks. — The ribs are more widely split than in *Hyphoplites falcatus interpolatus* Wright & Wright, while the upper ventro-lateral tubercles are smaller and more numerous than in *H. pseudofalcatus* (Semenov).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands 3—4, Mangyshlak (*cf.* Text-fig. 12).

Family **Schloenbachiidae** Parona & Bonarelli, 1897
Genus *SCHLOENBACHIA* Neumayr, 1875
(Type species: *Ammonites varians* J. Sowerby, 1817)

Diagnosis and discussion: See Juignet & Kennedy (1976, pp. 76—77) and Kennedy & *al.* (1979, pp. 28—30).

Remarks. — This genus is the most abundant one in the investigated collection (over a thousand specimens), present in all the investigated geological sections, especially in Mangyshlak (with the section of Sullu-kapy included). Paleontological revision of the genus *Schloenbachia* Neumayr has been undertaken by Dr. J. M. Hancock (King's College, London) whose work is still in preparation. Therefore, the present author postpones analysis of the collected schloenbachiids until Dr. Hancock's results will be published.

Hancock (*in* Juignet & Kennedy 1976, pp. 76—77; Kennedy & *al.* 1979, p. 29) is of the opinion that the Cenomanian representatives of *Schloenbachia* have been oversplit by paleontologists who did not take into account their intraspecific variability. He claims that there are only three species of *Schloenbachia* in the Cenomanian; namely, *S. varians* (J. Sowerby) in the Lower Cenomanian, *S. coupei* (Brongniart) in the Middle Cenomanian, and *S. lymense* Spath in the Upper Cenomanian (*cf.* also Kennedy & Juignet 1975, p. 1222; Kennedy & Hancock 1977, p. 133). According to Hancock, the species *S. varians* includes varieties ranging from the hypernodose *ventriosa* to almost smooth-shelled *subplana;* the species *S. coupei* includes the hypernodose forms *trituberculata* and *quadrata* to finely ornamented *costata;* whereas *S. lymense* is more or less monotypic. When meant as by Hancock (*cf.* also synonymy *in* Juignet & Kennedy 1976, pp. 78—79; Kennedy & *al.* 1979, p. 31), almost all schloenbachiid specimens of the present author's collection are to be attributed to one or another of these three species. If so, one has however to note that *S. varians* ranges into the Middle Cenomanian in the sections of Hoppenstedt quarry, MGU Station, and Sullu-kapy, while *S. coupei* appears in the upper Lower Cenomanian of the MGU Station section. The co-occurrence of the two species in the other investigated sections is largely an effect of stratigraphic condensation.

Occurrence. — The genus *Schloenbachia* Neumayr occurs in the Cenomanian of Europe and Mid-Asia, being commonly regarded as a typically Boreal form because its geographic distribution is like that of Boreal Albian hoplitids (*cf.* Owen 1971, p. 131; Kennedy & Cobban 1976, p. 75). The genus *Salteriсeras* Atabekyan, 1960 (type species: *Ammonites Salteri* Sharpe, 1856), which is ancestral to *Schloenbachia* and was included to the latter by some authors (Kennedy & *al.* 1979), occurs in the uppermost Albian of Mangyshlak and Kopet-Dag, the Soviet Union.

Family Placenticeratidae Hyatt, 1900
Genus *KARAMAITES* Sokolov, 1961
[=*Turkmenites* Iljin, 1975; *Kopetdagites* Iljin, 1975; *Mediasiaceras* Iljin, 1975; *Beschtubeites* Iljin, 1975]
(Type species: *Placenticeras grossouvrei* Semenov, 1899)

Diagnosis: Shell compressed, involute, with whorls higher than broad, with flat to convex flank and flat and narrow venter, sometimes rounded at the body chamber. Shell surface smooth or ornamented with sinuous or falcoid ribs associated with umbilical turbercles and ventro-lateral clavi. Ribs more distinct at the upper than at the lower part of a whorl, disappearing at later ontogenetic stages. Ventro-lateral clavi persistent throughout ontogeny, while umbilical tubercles change in ontogeny into wide and gentle swellings. Sutural line with three well-developed lateral lobes, low-situated third saddle, and weakly developed fourth lateral lobe which is always smaller than the fifth one (*cf.* Text-figs 13, 14a).

Remarks. — Sokolov (1961, p. 152) erected the genus *Karamaites* to embrace placenticeratids with a primitive sutural line showing, already at the whorl height of 2.5 mm, „a bipartite division of the first lateral lobe, which makes the new genus close to the genus *Cleoniceras;* while a bipartite division of the first lateral saddle by an accessory lobe makes it close to the genus *Placenticeras*". However, the most distinctive feature of *Karamaites* Sokolov is a reduction of the fourth lateral lobe which is unexceptionally smaller than the fifth one. This feature, displayed by Upper Albian to Lower Turonian placenticeratids, is a primitive character state, as there is an evolutionary trend towards an increase in size of the fourth lateral lobe which exceeds in size the fifth lobe in Upper Turonian and younger placenticeratids (see Text-fig. 14; *cf.* also Arkhangelsky 1916, Luppov 1963, Iljin 1975).

Discussion. — Iljin (1975) introduced some new genera (*Turkmenites, Kopetdagites, Mediasiaceras,* and *Beschtubeites*) for Cenomanian to Lower Turonian placenticeratids, distinguished after a variation in sutural line. The present author is of the opinion that this variation is too small to permit establishment of new taxa of generic rank, because all the four genera erected by Iljin (1975) exhibit a sutural line with three well-developed lateral lobes, low-situated third saddle, and the fourth lateral lobe being smaller in size than the fifth one (*cf.* Iljin 1975, Pl. 33, Figs 1—4, and Pl. 34, Figs 5—8); hence, they are consistent with the diagnosis of the genus *Karamaites.*

Occurrence. — The genus *Karamaites* Sokolov has been recorded in the Upper Albian to Lower Turonian of the Soviet Mid-Asia.

Karamaites grossouvrei (Semenov, 1899)
(Pl. 2, Figs 13—14)

1899. *Placenticeras(?) Grossouvrei* n. sp.; Semenov, p. 97, Pl. 3, Fig. 5.
1916. *Placenticeras grossouvrei* Semenov; Arkhangelsky, p. 521, Text-fig. 7.
1959. *Placenticeras grossouvrei* Semenov; Aliev & Aliev, p. 218, Pl. 2, Fig. 4.
1961. *Karamaites grossouvrei* (Semenov); Sokolov, p. 152.
1970. *Kopetdagites grossouvrei* Sem.; Iljin, pp. 10—11.
1974. *Placenticeras grossouvrei* Sem.; Manija, p. 100.

Material; Ferruginous moulds of inner whorls, Nos *II.P.20* (Pl. 2, Fig. 13), *II.P.10* (Pl. 2, Fig. 14), *I.P.31*, and *II.P.9*.

Description. — The umbilicus is relatively narrow, with steep wall; the whorls are high, with maximum thickness at the umbilical edge, and rather narrow and flat venter limited by distinct shoulders. There are 7—8 fine umbilical tubercles associated with hardly discernible falcoid ribs. The ribs become more and more distinct in ontogeny (*cf.* Pl. 2, Fig. 14*a*), especially at the upper part of whorls. Short intercalar ribs are confined to the upper part of whorls. The sutural line is only fragmentarily preserved. There is a wide ventral lobe, ended with accesso-

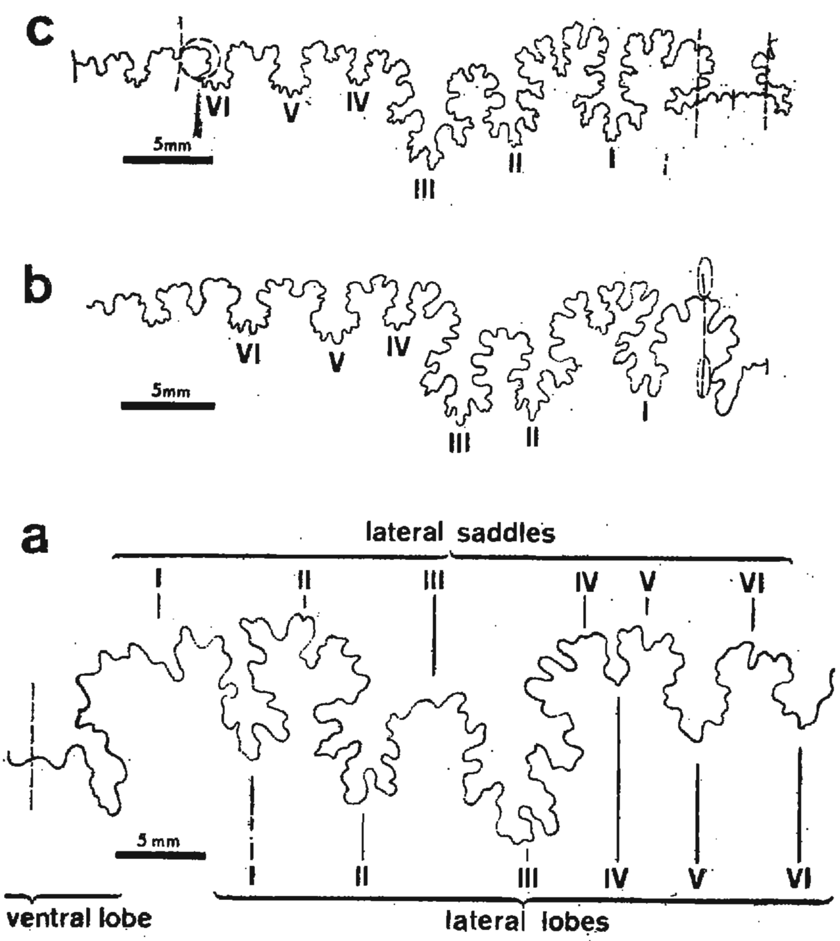


Fig. 13. Sutures of the genus *Karamaites* Sokolov, 1961, from the Mid-Asia regions of the Soviet Union, to show the morhological details discussed in the text

a — *K. grossouvrei* (Semenov, 1899); Cenomanian, Kiuren-Dag (*after:* Arkhangelsky, 1916, Text-fig. 7)

b — *K. gaurdakense* (Luppov, 1963); Middle Cenomanian, Gissarsk Chain (*after:* Luppov, 1963, Text-fig. 1)

c — *K. mediasiaticum* (Luppov, 1963); Middle Cenomanian, Gissarsk Chain (*after:* Luppov, 1963, Text-fig. 2) ry lobes trespassing the ventro-lateral shoulders. The first lateral lobe is rather narrow, subparallel to the siphuncle.

Table 11

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh
II.P.20	16.0	54.4	35.6	23.7	0.65
II.P.10	25.5	49.0	31.4	21.6	0.64

Remarks. — Inner whorls of *Karamaites grossouvrei* (Semenov) show no ventro-lateral clavi and only weakly developed ribs (*cf*. Pl. 2, Figs 13—14). Later in ontogeny, the ribs become more prominent and ventro-lateral clavi appear (*cf*. Aliev & Aliev 1959, Pl. 2, Fig. 4). Finally, the ribs disappear and the ornamentation consists of umbilical tubercles and ventro-lateral clavi (*cf*. Semenov 1899, Pl. 2, Fig. 5). A similar change in ornamentation in ontogeny occurs in *K. gaurdakense*

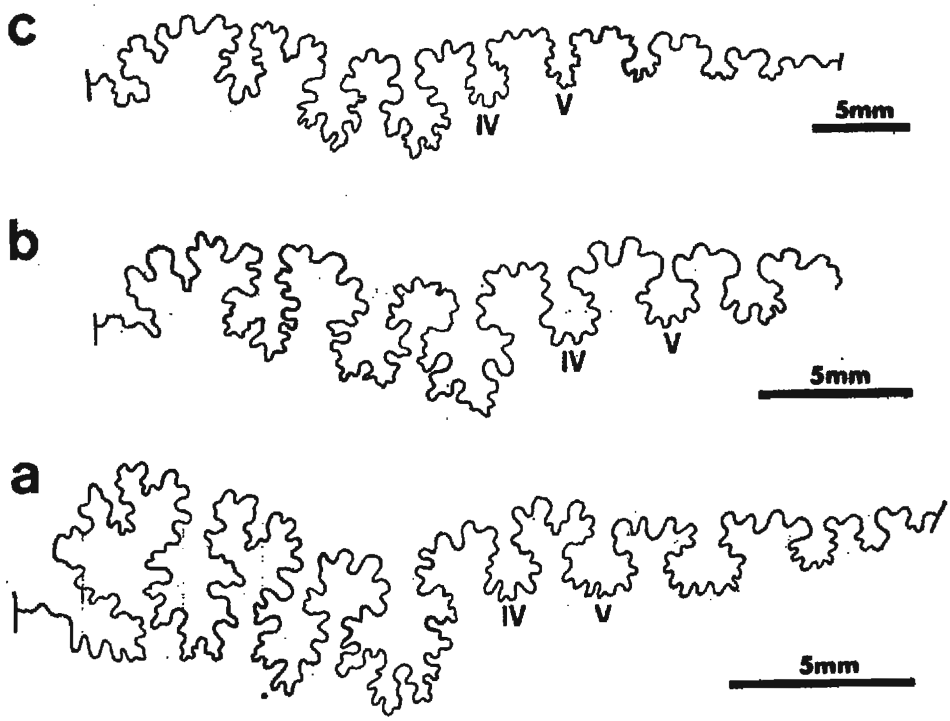


Fig. 14. Size variability of the *IV* and *V* lateral lobes in some low-Upper Cretaceous placenticeratids from the Mid-Asia regions of the Soviet Union

a — *Karamaites kutuzovae* (Iljin, 1975); Lower Turonian, Besh-Tube, Amudaria river (*after:* Iljin, 1975, Pl. 34, Fig. 8); *IV* lateral lobe is slightly smaller than *V*

b — *Proplacenticeras proplanum* Iljin, 1975; Upper Conacian, Koshabulak, Amudaria river (*after:* Iljin, 1975, Pl. 35, Fig. 10e); *IV* lateral lobe is larger than *V*

c — *Placenticeras luppovi* Iljin, 1975; Lower Santonian, Akrabat, Gissarsk Chain (*after:* Iljin, 1975, Pl. 35, Fig. 13b); *IV* lateral lobe is distinctly larger than *V*

(Luppov), different from *K. grossouvrei* in its wider venter and especially in its sutural line. In fact, *K. gaurdakense* shows a rather narrow ventral lobe ended well with accessory lobes subparallel to the siphuncle but not trespassing the ventro-lateral shoulders, while its first lateral lobe is curved towards the siphuncle (Luppov 1963, p. 145, Text-fig. 1).

Occurrence. — No. *I.P.31*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); Nos *II.P.9*, *II.P.10*, *II.P.20*: Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands *7—9*, Mangyshlak (*cf.* Text-fig. 12).

The species *Karamaites grossouvrei* (Semenov) is widespread in the Cenomanian of the Soviet Mid-Asia (Mangyshlak, Kopet-Dag, Tadzhikistan). Some authors regard it as the index fossil of the lowermost subzone of the Middle Cenomanian in the local stratigraphic subdivision (*cf.* Dzhaborov & *al.* 1964, Manija 1974), which seems to be incorrect because *K. grossouvrei* occurs also in the Lower Cenomanian in the section of Sullu-kapy, and the specimen described by Semenov (1899) probably was found in the Lower Cenomanian [along with *Hyphoplites falcatus* (Mantell)] of Bichatky (= ?Besakty) section.

Karamaites mediasiaticum (Luppov, 1963)
(Pl. 2, Figs 10—12)

1963. *Placenticeras mediasiaticum* Luppov sp. n.; Luppov, pp. 146—148, Text-fig. 2, Pl. 2, Fig. 1.

Material: Seven ferruginous moulds of inner whorls, Nos *II.P.3* (Pl. 2, Fig. 10), *II.P.1* (Pl. 2, Fig. 11), *II.P.2* (Pl. 2, Fig. 12), *II.P.4*, *II.P.5*, *II.P.6* and *II.P.7*.

Table 12

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh
II.P.5	14.0	53.6	30.0	19.3	0.56
II.P.7	15.2	53.9	27.6	18.4	0.51
II.P.6	19.4	54.1	26.3	16.0	0.48
II.P.2	20.1	53.7	26.9	18.4	0.50
II.P.3	20.4	52.9	27.0	17.1	0.51
II.P.1	21.5	51.6	24.6	17.7	0.48

Description. — The umbilicus is narrow, with steep wall. The whorls are twice as high as broad, with maximum thickness a little above the umbilical edge, and narrow and flat venter limited by distinct shoulders. The shell surface is smooth, except for 4—5 fine, somewhat oblique, umbilical tubercles giving the origin to even finer, singular, falcoid ribs, which ornamentation appears in the specimens Nos *II.P.1* and *II.P.3* when enlarged ×4 but not in the photos (*cf.* Pl. 2, Figs 10—11). The sutural line is well-preserved. The ventral lobe is wide, ended with accessory lobes considerably trespassing the ventro-lateral shoulders. The first and second lateral lobes are narrow, the first one being ended with three small accessory lobes almost perpendicular to one another, just as it is the case with the specimen illustrated by Luppov (1963, Text-fig. 2).

Remarks. — The species *Karamaites mediasiaticum* (Luppov) differs from *K. grossouvrei* (Semenov), recorded in the same beds, in its narrower umbilicus and venter, more slender whorls, and almost complete absence of shell ornamentation (*cf.* Pl. 2, Figs 10—12 and 13—14, respectively). The investigated specimens (14 to 21.5 mm in shell diameter) present only the inner, almost non-ornamented whorls, while a distinct ornamentation consisting of ribs and tubercles appears in *K. mediasiaticum* only at a diameter of 35—40 mm. Even then, the ornamentation is less conspicuous than in other Cenomanian Mid-Asiatic placenticeratids (*cf.* Luppov 1963, p. 147). The sutural line of the investigated specimens is consistent in outline with that observed in the type specimen of the species (*cf.* Luppov 1963, Text-fig. 2), even though the accessory lobes and saddles are less distinct because of the earlier ontogenetic stage.

Occurrence. — Middle Cenomanian, Sullu-kapy, *II* faunal horizon, Bands 7—9, Mangyshlak (*cf.* Text-fig. 12).

The species *Karamaites mediasiaticum* (Luppov) has been recorded in the Cenomanian (possibly only the Middle Cenomanian) of the Soviet Union (Mangyshlak, Kopet-Dag, and possibly Emba region in Kazakhstan).

Superfamily **Acanthocerataceae** Hyatt, 1900
Family **Acanthoceratidae** Hyatt, 1900
Subfamily **Mantelliceratinae** Hyatt, 1900
Genus *MANTELLICERAS* Hyatt, 1900
(Type species: *Ammonites mantelli* J. Sowerby, 1814)

Remarks. — Some authors (*e.g.* Busnardo 1966, Thomel 1972, Renz & Jung 1978) recognize various subgenera within the genus *Mantelliceras* Hyatt. When the genus is diagnosed as by Matsumoto & *al.* (1957, p. 5) and Kennedy (1971, pp. 49—50), the hitherto recognized subgenera do not differ from one another to any significant extent, while the differences referred to by the above cited authors either are of at most specific rank, or reflect a comparison of specimens representative of variable developmental stages. Therefore, the present author follows Kennedy (1971) and Juignet & Kennedy (1976) and postpones the use of subgeneric names until the genus *Mantelliceras* will be more comprehensively studied; this opinion is also shared by Matsumoto & Inoma (1975, p. 281).

Occurrence. — The genus *Mantelliceras* Hyatt shows a world-wide distribution, having been recorded in the Lower Cenomanian of Europe, the Soviet Union, northern and southern Africa and Madagascar, Asia (Iran, India, and Japan), Western Interior of the United States, and South America (Brazil).

Mantelliceras mantelli (J. Sowerby, 1814)
(Pl. 9, Figs 5—9; Pl. 10, Figs 1—2)

1857. *Ammonites Mantelli*, Sowerby; Sharpe [*partim*], pp. 40—41 Pl. 18, Fig. 7.
1858—1860. *Ammonites Mantelli*, Sowerby; Pictet & Campiche [*partim*], pp. 200—206 [non Pl. 26, Figs 1—2 = *M. picteti*, Fig. 3a—b, ?3c = *M. tenue*, Fig. 4 = ?form transitional between *M. mantelli* and *M. tuberculatum*, Fig. 5 = *M. tuberculatum*].
1863. *Ammonites Mantelli*, Sow.; Pictet pp. 22—23.
1871. *Ammonites Mantelli* Sow.; Schlüter [*partim*], pp. 12—14, Pl. 5, Figs 1—2, 7—8, and ?5—6 [non Pl. 5, Figs 3—4=?*M. cantianum*; Pl. 6, Figs 1—2 and 11=?*M. saxbii*].
1897. *Acanthoceras Mantelli* Sow.; Kossmat, pp. 23—24, Pl. 4, Fig. 4.
1910. *Acanthoceras Mantelli* Sowerby; Pervinquière, p. 41, Pl. 4, Fig. 1.
1951. *Mantelliceras mantelli* (J. Sowerby); Wright & Wright, p. 24.
1959. *Mantelliceras mantelli* Sow.; Aliev & Aliev, pp. 215—217, Pl. 2, Figs 3 and ?2.
1959. *Mantelliceras mantelli* (Sowerby); Cieśliński, pp. 63—64.
1959. *Mantelliceras mantelli* (Sowerby); Naidin & Shimanskij [*partim*], pp. 183—184, Pl. 18, Figs 1 and ?3 [non Fig. 2 = ?*M. lateretuberculatum*].
1963. *Mantelliceras (Mantelliceras) mantelli* (J. Sowerby); Renz, pp. 1100—1101, Pl. 2, Fig. 3; Pl. 4, Figs 5—6 and ?4.

1964. *Mantelliceras mantelli* J. Sow.; Collignon, pp. 27 and 66, Pl. 323, Fig. 1436, Pl. 337, Figs 1507—1508.
1969. *Mantelliceras mantelli* (Sowerby); Kennedy, p. 545, Pl. 15, Figs 1—2.
1971. *Mantelliceras mantelli* (J. Sowerby); Kennedy, pp. 54—55, Pl. 17, Figs 9—10.
1971. *Mantelliceras* aff. *mantelli* (J. Sowerby); Kennedy, Pl. 20, Fig. 2, Pl. 23, Fig. 2.
1972. *Mantelliceras (Mantelliceras) mantelli* (Sowerby); Thomel, [*partim*], pp. 37—39, Pl. 10, Figs 3—12, Pl. 11, Figs 1 and 7—8 [non Pl. 11 Figs 5—6 = *Mantelliceras* sp. juv. according to Juignet & Kennedy 1976].
1976. *Mantelliceras mantelli* (J. Sowerby); Juignet & Kennedy, pp. 86—87, Pl. 12, Fig. 2, Pl. 17, Fig. 4.
1976. *Mantelliceras mantelli* (J. Sowerby); Kennedy & Hancock, p. 37, Pl. 5, Figs 3—4.
1979. *Mantelliceras mantelli* (J. Sowerby, 1814); Immel, pp. 623—624, Pl. 2, Figs 3—4.

Material: A dozen specimens, Nos *I.M.29* (Pl. 9, Fig. 5), *Tr 9* (Pl. 9, Fig. 6), *Tr 12* (Pl. 9, Fig. 7), *Tr 14* (Pl. 9, Fig. 8), *Tr 15* (Pl. 9, Fig. 9), *125.1* (Pl. 10, Fig. 1), *133.68* (Pl. 10, Fig. 2), *126.1*, *134.68*, *139.5230-2*, *141.5230-2*, and *142.5230-2*.

Table 13

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Re
I.M.29	14.0	47	46	29	0.97	20	10	10
Tr 9	58.8	45		29		(2/3) 22	9	13
Tr 12	34.5	47		25		(1/2) ca 16	8-7	8-9
Tr 14	48.5	40		32		30	13	17
Tr 15	41.5	46		31		30	14	16

Remarks. — The specimen No. *I.M.29* (Pl. 9, Fig. 5) presents a prefectly preserved nucleus, with whorls square in intercostal cross section, regularly ornamented with alternating short and long ribs. The long ribs bear fine umbilical tubercles, very weakly developed lateral tubercles or rib swellings (they appear only at the last three ribs of the specimen), and distinct lower and upper ventro--lateral tubercles. The latter two groups of tubercles occur also at the short ribs, being developed like at the long ones, that is the lower ventro-lateral tubercles being somewhat smaller than the others. These characteristics make the specimen under discussion close to that one illustrated by Collignon (1964, p. 27, Pl. 323, Fig. 1436).

All the other specimens are more or less diagenetically compressed. Some of them show rather conspicuously ornamented whorls (*cf.* Pl. 9, Figs 6 and 8—9) which makes them similar to those described by Renz (1963) from the Neuenburger Jura rather than to those reported from France and England (*cf.* Kennedy 1971, Juignet & Kennedy 1976).

A variation in shell ornamentation appears in the investigated specimens at a large diameter (these are forms probably with partly preserved body chamber). The specimens Nos *125.1* (Pl. 10, Fig. 1) and *126.1* display rather sparsely spaced but strong ribs, with the long ribs bearing each not only an upper ventro-lateral tubercle, but also swellings representing lower ventro-lateral, lateral, and umbilical tubercles. Such an ornamentation resembles *Mantelliceras tuberculatum* (Mantell) and *M. lateretuberculatum* Collignon, and makes the specimens under discussion close to that presented by Thomel (1972, Pl. 11, Fig. 1). In turn, the specimen No. *133.68* (Pl. 10, Fig. 2) shows a finer and more densely spaced ribbing, which results in an affinity to that one figured by Collignon (1964, Pl. 337, Fig. 1508).

Typical adults of *M. mantelli* (J. Sowerby) display not more than 40 ribs per whorl, which makes a difference from *M. mantelli percostata* Collignon (1964, Pl. 338, Fig. 1510) showing 50 ribs per whorl.

The species *M. mantelli* is highly variable and intermediate in ornamentation between *M. saxbii* (Sharpe) and *M. tuberculatum* (Mantell). Relatively strongly ornamented forms with prominent tubercles persistent up to a large diameter and relatively inflated whorl cross section are transitional to *M. tuberculatum*. In contrast, those forms with less conspicuous shell ornamentation and more compressed whorl cross section are transitional to *M. saxbii*.

Occurrence. — Nos *Tr 9*, *Tr 12*, *Tr 14*, *Tr 15*: Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2); No. *I. M. 29*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); Nos *125.1*, *126.1*: Lower Cenomanian, Mt. Selbukhra, Band *I* (green, sandy-glauconitic marls close to the boundary with the Upper Albian), Crimea (*cf.* Text-fig. 6); No. *133.68*: Lower Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9); Nos *139.5230-2*, *141.5230-2*, *142.5230-2*: Lower Cenomanian, Rubas--chaj, Dagestan Caucasus (*cf.* Text-fig. 10).

The species *Mantelliceras mantelli* (J. Sowerby) has been reported from the Lower Cenomanian of Europe, northern Africa, Madagascar, India, and the Soviet Union (Crimea, Caucasus, Mangyshlak, Kopet-Dag).

Mantelliceras aff. *mantelli* (J. Sowerby, 1814)
(Pl. 10, Figs 3—4)

Material: Two specimens, Nos *Tr 11* (Pl. 10, Fig. 3) and *Tr 17* (Pl. 10, Fig. 4).

Table 14

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 11	50.7	47	23	$\left(\frac{1}{2}\right)$18	8-9	10-9
Tr 17	60.0	45	27	32	16	16

Remarks. — The specimens under discussion are more finely ornamented than typical representatives of *Mantelliceras mantelli* (J. Sowerby). Lower ventro--lateral and lateral tubercles are confined to the inner whorls (up to 25—30 mm in shell diameter) in the specimen No. *Tr 11* (Pl. 10, Fig. 3), which makes it transitional to *M. ventnorense* Diener. In turn, the specimen No. *Tr 17* (Pl. 10, Fig. 4) shows four tubercles at each long rib, but the ribs and the tubercles are weakly developed, which results in an affinity to *M. saxbii* (Sharpe).

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

Mantelliceras saxbii (Sharpe, 1857)
(Pl. 9, Figs 1—2)

1822. *Ammonites Mantelli* (of Sowerby) Var. *costata*; Mantell [*partim*], p. 114, Pl. 22, Fig. 1.
1857. *Ammonites Mantelli*, Sowerby; Sharpe [*partim*], pp. 40—41, Pl. 18, Fig. 4.

1857. *Ammonites Saxbii*, Sharpe; Sharpe, p. 45, Pl. 20, Fig. 3.
1971. *Mantelliceras saxbii* (Sharpe); Kennedy & Hancock, pp. 437—441, Text-fig. 1a, e, Pl. 79, Figs 1, 3, Pl. 80, Figs 1—5, and Pl. 82, Fig. 2 [*cum syn.*].
1971. *Mantelliceras* aff. *saxbii* (Sharpe); Kennedy & Hancock, pp. 437—441, Text-fig. 1d, Pl. 79, Figs 2, 4—5, Pl. 81, Fig. 1, Pl. 82, Figs 4 and ?5.
1974. *Mantelliceras saxbii* (Sharpe, 1857); Marcinowski, p. 176, Pl. 33, Fig. 3 [*cum syn.*].
1976. *Mantelliceras saxbii* (Sharpe); Juignet & Kennedy, pp. 97—98, Pl. 19, Fig. 1 [*cum syn.*].
1976. *Mantelliceras* aff. *saxbii* (Sharpe); Juignet & Kennedy, pp. 98—99, Pl. 19, Figs 5—6, ?8, and ?10.
1976. *Mantelliceras hyatti* Spath; Wiedmann & Kauffman, p. 14, Pl. 4, Fig. 3.
1976. *Mantelliceras saxbii* (Sharpe); Kennedy & Hancock, p. 37, Pl. 6, Figs 1—2 and 6.
1979. *Mantelliceras saxbii* (Sharpe); Wiedmann & Schneider, pp. 670—671, Pl. 10, Fig. 3.

Material: Two specimens, Nos *I.M.27* (Pl. 9, Fig. 1) and *Tr 10* (Pl. 9, Fig. 2).

Table 15

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
I.M.27	23.3	51	41	23	0.81	$\left(\frac{1}{2}\right)$16	6	10

Remarks. — The specimen No. *I.M.27* (Pl. 9, Fig. 1) shows whorls much higher than broad, with long ribs with moderately developed umbilical tubercles, small sized and indistinct lower ventro-lateral tubercles, and prominent upper ventro-lateral tubercles. There are 1—2 short ribs between each two long ones, each with a lower and upper ventro-lateral tubercle developed as at the long ribs. These characteristics resemble most closely forms with whorl cross section somewhat broader than in the lectotype, identified by Juignet & Kennedy (1976, p. 98, Pl. 19, Fig. 5) as *Mantelliceras* aff. *saxbii* (Sharpe); the present author is of the opinion that these forms fall within the range of intraspecific variability of *M. saxbii*. The investigated specimen differs from nuclei of *M. mantelli* (J. Sowerby) described from the same bed in its less prominent lower and upper ventro-lateral tubercles, much narrower whorls, and the absence of regular alternation of long and short ribs (*cf.* Pl. 9, Figs 1 and 5, respectively).

The other specimen, No. *Tr 10* (Pl. 9, Fig. 2), shows some 38 ribs per whorl, which indicates that it represents a subadult developmental stage (*cf.* Kennedy & Hancock 1971, p. 440). The long ribs bear small umbilical tubercles and moderately prominent upper ventro-lateral ones. The short ribs (their number cannot be recognized because of the poor preservation state) show only upper ventro-lateral tubercles. This fine ornamentation makes the investigated specimen close to that one figured by Juignet & Kennedy (1976, Pl. 19, Fig. 1), and makes a difference from *Mantelliceras costatum* (Mantell) derived from the same bed (*cf.* Pl. 11, Figs 2—3).

Occurrence. — No. *I.M.27*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); No. *Tr 10*: Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Mantelliceras saxbii* (Sharpe) has been reported from the Lower Cenomanian of Europe (England, France, GFR and GDR, Switzerland, Poland), northern Africa (Tunisia, Algeria) and Madagascar, and Asia (India, Kopet-Dag in the Soviet Union).

Mantelliceras aff. *ventnorense* Diener, 1925
(Pl. 9, Fig. 3)

Material: Well preserved, phosphatic mould, No. *A.H.M.1.*

Table 16

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
A.H.M.1	61.5	38	36	30	0.95	34	ca 11-13	23-21

Remarks. — The flexuous ribs and the absence of lower ventro-lateral and lateral tubercles observed in the investigated specimen (Pl. 9, Fig. 3) are diagnostic of the species *ventnorense* Diener. However, the specimen under study differs from typical representatives of that species (*cf.* Sharpe 1857, Pl. 23, Fig. 6; Collignon 1964, Pl. 347, Fig. 1547) in its broader whorl cross section (*Wb*: *Wh*=0.95), more prominent ribs, and wider umbilicus. The latter two features make its affinity to *Mantelliceras saxbii* (Sharpe), a close relative of *M. ventnorense* (cf. Kennedy 1971, p. 63; Kennedy & Hancock 1971, p. 444).

Occurrence. — Lower to mid-Middle Cenomanian condensed sequence at Annopol, Holy Cross Mts, Poland (*cf.* Text-fig. 3).

Mantelliceras picteti Hyatt, 1903
(Pl. 9, Fig. 4)

1858—1860. *Ammonites Mantelli*, Sowerby; Pictet & Campiche [*partim*], pp. 200 and 203, Pl. 26, Figs 1—2 [non Figs 3—5].

1972. *Mantelliceras (Promantelliceras) picteti* Hyatt: Thomel, pp. 31—32, Pl. 4, Figs 1—3, Pl. 6, Figs 5—6, and ?Pl. 7, Fig. 12.

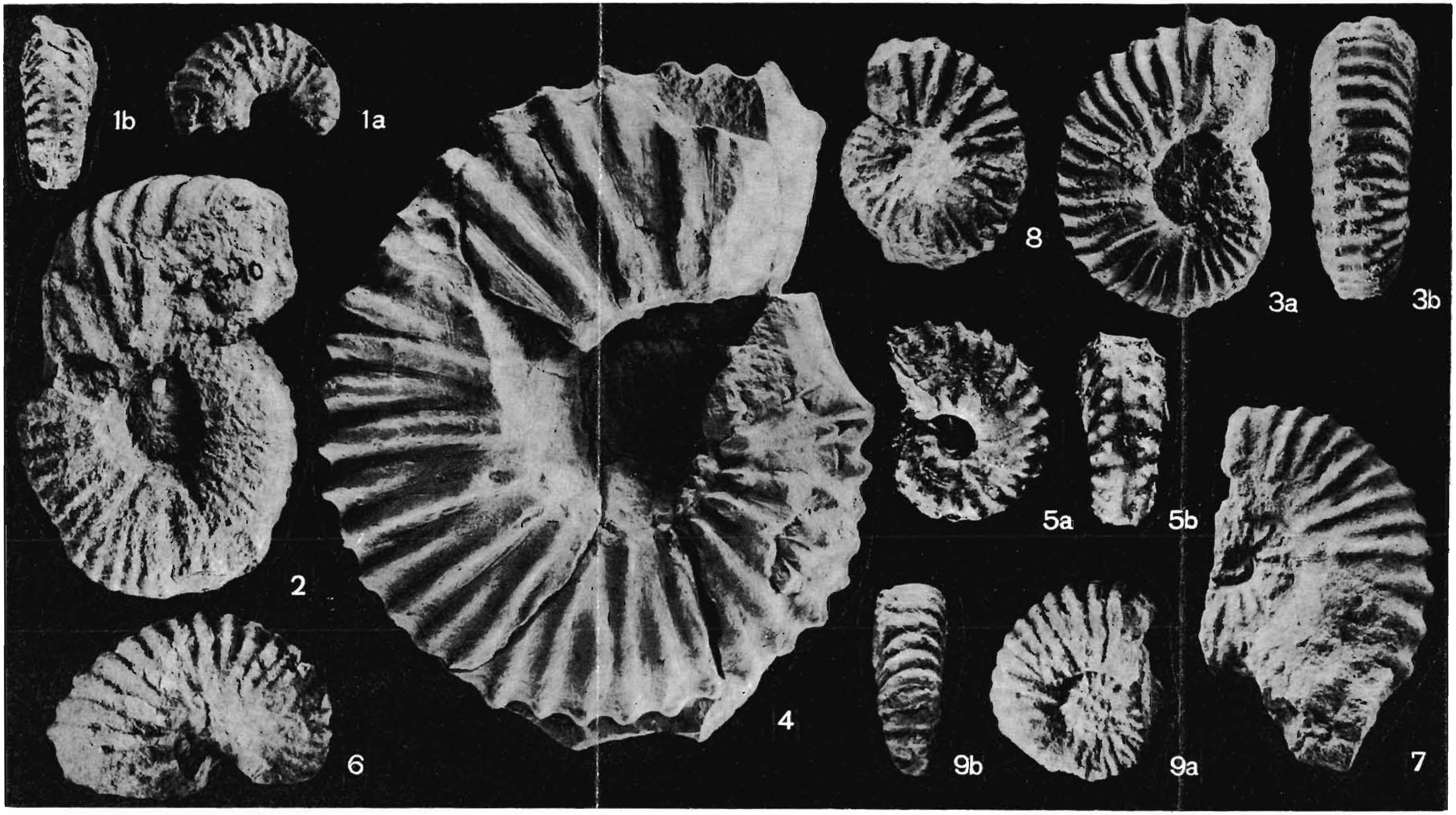
1976. *Mantelliceras (Promantelliceras) picteti* Hyatt; Renz & Jung, p. 15.

Material: One specimen, No. *120.7755-12*.

Table 17

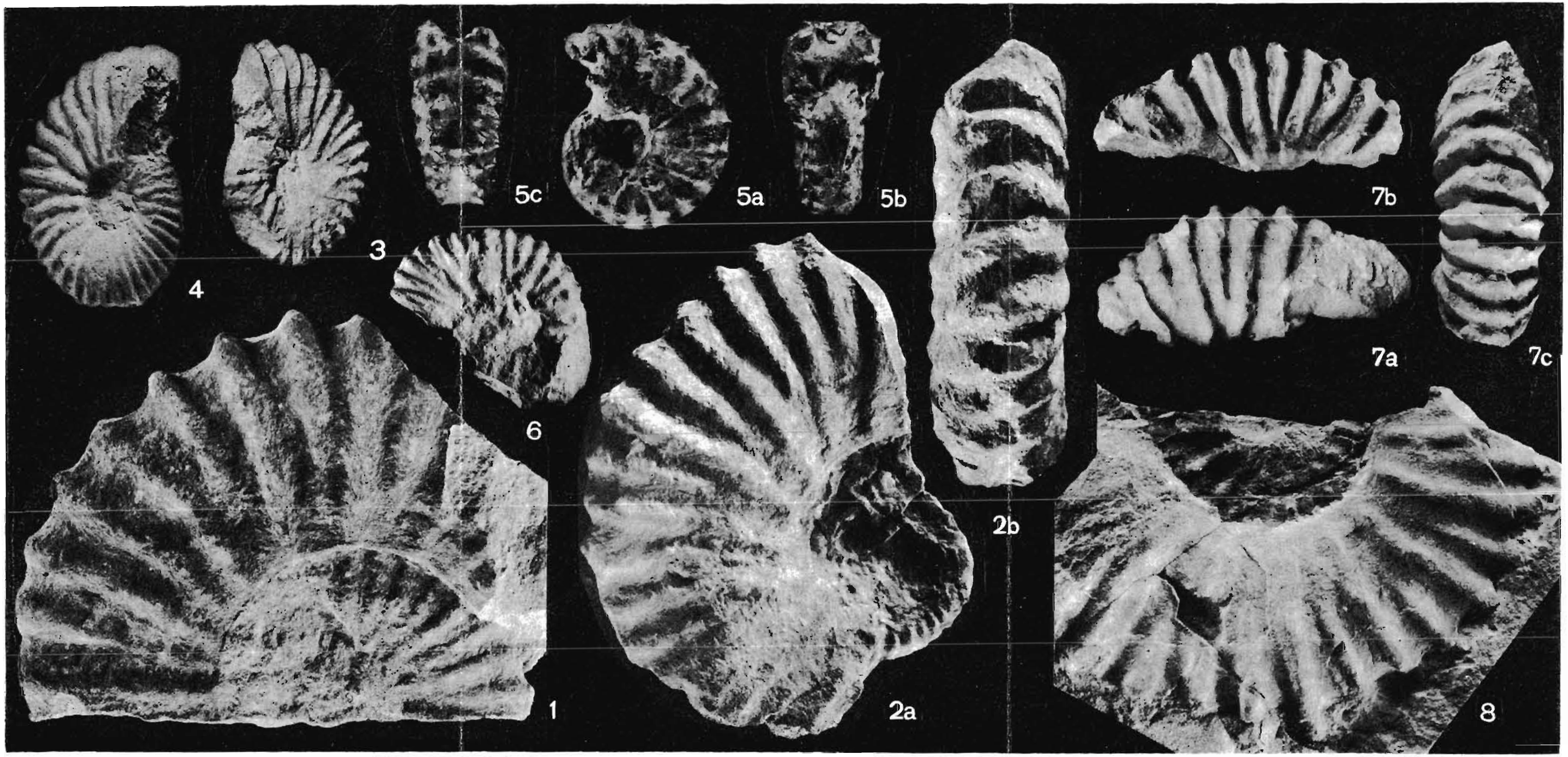
Specimen No.	D mm	Wh %	U %	R	Rp	Rs
120.7755-12	135.5	35	?35	ca 38	19	19

Remarks. — The investigated specimen (Pl. 9, Fig. 4) shows relatively fine and densely spaced, regularly alternating short and long ribs. In the outer part of the last whorl the long ribs bear only upper ventro-lateral tubercles, while umbilical tubercles are merely in form of a swelling. The ornamentation and the umbilicus width make the specimen under discussion almost indistinguishable from those described and illustrated by Thomel (1972, p. 32, Pl. 4, Figs 1—3). It resembles also densely ribbed forms of *Mantelliceras mantelli* (J. Sowerby)



Mantelliceras saxbii (Sharpe): **1** — specimen No. I.M.27, Lower Cenomanian, Sullu-kapy, Bands 3—4 (*I* faunal horizon), × 1.5; **2** — No. Tr 10, Lower Cenomanian, Hoppenstedt. **Mantelliceras aff. ventnorense** Diener: **3** — specimen No. A.H.M.1, Lower Cenomanian, condensed sequence at Annopol. **Mantelliceras picteti** Hyatt: **4** — specimen No. 120.7755-12, Lower Cenomanian, MGU Station, Band IV-1 Bed 1. **Mantelliceras mantelli** (J. Sowerby): **5** — specimen No. I.M.29, Lower Cenomanian, Sullu-kapy, Bands 3—4 (*I* faunal horizon), × 3; **6** — No. Tr 9, **7** — No. Tr 12, **8** — No. Tr 14, **9** — No. Tr 15; Lower Cenomanian, Hoppenstedt

All figures are of natural size, except Figs 1 and 5



Mantelliceras mantelli (J. Sowerby): **1** — specimen No. 125.1, Lower Cenomanian, Mt. Selbukhra, Band I; **2** — No. 133.68, Lower Cenomanian, Ajmaki. **Mantelliceras** aff. **mantelli** (J. Sowerby): **3** — specimen No. Tr 11, form transitional to *M. ventnorense* Diener; **4** — No. Tr 17 (cast), form close to *M. saxbii* (Sharpe); Lower Cenomanian, Hoppenstedt. **Mantelliceras tuberculatum** (Mantell): **5** — specimen No. I.M.30, Lower Cenomanian, Sullu-kapy, Bands 3—4 (I faunal horizon), ×3.4; **6** — No. 122.7629, Lower Cenomanian, MGU Station, ?Band IV-1; **7** — No. 135.66, Lower Cenomanian, Ajmaki. **Mantelliceras lateretuberculatum** Collignon: **8** — specimen No.181.7508-3, Lower Cenomanian, Mt. Kremennaya or Mt. Selbukhra

All figures are of natural size, except Fig. 5

(*cf.* Collignon 1964, Pl. 337, Fig. 1508), from which it differs in its much wider umbilicus and almost rectiradiate ribs. Other representatives of the latter species differ from *M. picteti* Hyatt in their more prominent and sparsely spaced ribs at a diameter of 140 mm and more (*cf.* Pl. 10, Fig. 1; Thomel 1972, Pl. 11, Fig. 1), and a narrower umbilicus (less than 30% of shell diameter, as a rule).

The insufficient material makes impossible a reconsideration of various subspecies recognized within the species *picteti* Hyatt by Thomel (1972).

Occurrence. — Lower Cenomanian, MGU Station, Band *IV-1* (Bed *1*), Crimea (*cf.* Text-fig. 6).

The species *Mantelliceras picteti* Hyatt occurs in the Lower Cenomanian of the French Subalpine Chain (base of the Zone *2* of Thomel 1972) and the Swiss Jura Mts.

Mantelliceras tuberculatum (Mantell, 1822) (Pl. 10, Figs 5—7)

1822. *Ammonites Mantelli* (of Sowerby) Var. *tuberculata*; Mantell, p. 114.
1857. *Ammonites Mantelli*, Sowerby Var. *A*; Sharpe, pp. 40—41, Pl. 18, Fig. 6.
1858—1860. *Ammonites Mantelli*, Sowerby; Pictet & Campiche [*partim*], p. 202, Pl. 26, Fig. 5.
1971. *Mantelliceras tuberculatum* (Mantell); Kennedy, pp. 61—62, Pl. 24, Figs 2—3, 5, 7, and Pl. 25, Fig. 1 [*cum syn.*].
1971. *Mantelliceras* aff. *tuberculatum* (Mantell); Kennedy, Pl. 24, Fig. 4.
1972. *Mantelliceras (Neomantelliceras) tuberculatum* (Mantell); Thomel, pp. 43—44, Pl. 12, Figs 1, 5, Pl. 13, Figs 5, 7—9.
1978. *Mantelliceras tuberculatum* (Mantell); Juignet & Kennedy, pp. 93—94, Pl. 13, Fig. 5, Pl. 14, Figs 2—3, Pl. 19, Fig. 9, and Pl. 21, Fig. 4.
1976. *Mantelliceras tuberculatum* (Mantell); Wiedmann & Kauffman, p. 14, Pl. 4, Fig. 4.
1979. *Mantelliceras tuberculatum* (Mantell, 1822); Immel, pp. 625—626, Pl. 3, Fig. 2.
1979. *Mantelliceras tuberculatum* (Mantell); Wiedmann & Schneider, p. 668, Pl. 9, Fig. 5.

Material: Five specimens, Nos *I.M.30* (Pl. 10, Lig. 5), *122.7629* (Pl. 10, Fig. 6), *135.66* (Pl. 10, Fig. 7), *I.M.30a*, and *I.M.30b*.

Table 18

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
I.M.30	14.9	47	47	30	1	20	10	10
122.7629	42.4	41		?37		$\left(\frac{1}{2}\right)$17	6	11

Remarks. — The specimen No. *I.M.30* (Pl. 10, Fig. 5) presents a very well preserved nucleus with shell ornamentation being stronger and whorl cross section being broader than in the above described nucleus of *Mantelliceras mantelli* (J. Sowerby) (*cf.* Pl. 9, Fig. 5). Later developmental stages (Pl. 10, Figs 6—7) do also show a coarse ribbing and strong tubercles.

Occurrence. — Nos *I.M.30, I.M.30a, I.M.30b*: Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12); No. *122.7629*: Lower Cenomanian, MGU Station, supposedly Band *IV-1*, Crimea (*cf.* Text-fig. 6); No. *135.66*: Lower Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text-fig. 9).

The species *Mantelliceras tuberculatum* (Mantell) has been recorded in the Lower Cenomanian of England, France, Switzerland, GFR, Poland, Algeria, Madagascar, and possibly the Soviet Union (Kopet-Dag).

Mantelliceras lateretuberculatum Collignon, 1964
(Pl. 10, Fig. 8)

1964. *Mantelliceras lateretuberculatum* nov. sp.; Collignon, pp. 90 and 94, Pl. 348, Figs 1548, and Pl. 349, Fig. 1552.
?1959. *Mantelliceras mantelli* (Sowerby); Naidin & Shimanskij [*partim*], pp. 193—194, Pl. 18, Fig. 2.
1976. *Mantelliceras lateretuberculatum* Collignon; Juignet & Kennedy, p. 90, Pl. 15, Figs 1—2, and Pl. 16, Fig. 2.
?1976. *Mantelliceras* aff. *lateretuberculatum* Collignon; Juignet & Kennedy, Pl. 22, Figs 1—2.
1979. *Mantelliceras lateretuberculatum* Collignon; Wiedmann & Schneider, pp. 668—669, Text-fig. 10A and Pl. 10, Fig. 1.

Material: One specimen, No. *181.7508-3*.

Table 19

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
181.7508-3	ca 51	35	38	$(\frac{1}{2})$16	8	8
	ca 128	37	37	$(\frac{1}{3})$14	7	7

Remarks. — The investigated specimen (Pl. 10, Fig. 8) shows massive, thickening upwards, long ribs regularly alternating with short ones. There are four tubercles at each long rib, namely a small umbilical tubercle, prominent mid-lateral and lower ventro-lateral ones, and larger-sized and more pointed upper ventro-lateral one; whereas the short ribs display only lower and upper ventro-lateral tubercles. However, umbilical and mid-lateral tubercles disappear also at the outer part of the last whorl, replaced with indistinct swellings. The ribs incline backwards in the mid-lateral tubercles. This ornamentation resembles rather closely that in the specimens illustrated by Collignon (1964, Pl. 349, Fig. 1552) and Juignet & Kennedy (1976, Pl. 15, Fig. 2), the only difference consisting in the much wider umbilicus of the investigated specimen which may, however, be an artifact of diagenetic deformation.

The species *Mantelliceras lateretuberculatum* Collignon differs from its close relative *M. indianense* (Hyatt) in its less conspicuous ornamentation, especially the tubercles (the umbilical tubercles equal the mid-lateral ones in the latter species).

Occurrence. — Lower Cenomanian marls, Mt. Kremennaya or Mt. Selbukhra, Band *II* or Band *III*, Crimea (*cf*. Text-figs 5*a* and 6).

The species *Mantelliceras lateretuberculatum* Collignon has been reported from the Lower Cenomanian of France, GFR, and Madagascar.

Mantelliceras tenue Spath, 1926
(Pl. 11, Fig. 1)

1858—1860. *Ammonites Mantelli*, Sowerby; Pictet & Campiche [*partim*], p. 203, Pl. 26, Fig. 3.
1926b. *Mantelliceras tenue*, nom. nov.; Spath, pp. 427 and 430.
1963. *Mantelliceras (Mantelliceras) tenue* Spath; Renz, pp. 1108—1109, Pl. 2, Fig. 4.
1971. *Mantelliceras tenue* Spath; Kennedy, pp. 60—61, Pl. 20, Fig. 6, and Pl. 23, Fig. 3.
1972. *Mantelliceras (Promantelliceras) tenue* Spath; Thomel, p. 35.

1976. *Mantelliceras tenue* Spath; Juignet & Kennedy, p. 89, Pl. 16, Fig. 1, and Pl. 22, Fig. 4.
?non 1976. *Mantelliceras* cf. *tenue* Spath; Juignet & Kennedy, Pl. 19, Fig. 4 [= ?form transitional to *M. costatum*; cf. Kennedy 1971, Pl. 19, Fig. 1a].
1978. *Mantelliceras (Promantelliceras) tenue* Spath; Renz & Jung, p. 15.

Material: Well preserved, phosphatized phragmocone part, No. *P.H.M.2*.

Table 20

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
P.H.M.2	69.3	47	35	27	0.74	32	14	18

Remarks. — The investigated specimen shows narrow whorls and long ribs with well developed umbilical, lateral, and lower and upper ventro-lateral tubercles (Pl. 11, Fig. 1). There are also short (intercalar) ribs, one or sometimes two between each two long ribs, each with a lower and upper ventro-lateral tubercle. The short ribs are as distinct as the long ones in proximity of the latero-ventral shoulder and at the venter.

Occurrence. — Cenomanian condensed sequence at Podzametschek by Butschatsch in the Podolia, Soviet Union (*cf.* Text-fig. 4).

The species *Mantelliceras tenue* Spath has been reported from the Lower Cenomanian of England, France, and Switzerland.

Mantelliceras costatum (Mantell, 1822)
(Pl. 11, Figs 2—3)

1822. *Ammonites Mantelli* (of Sowerby) Var. *costata*; Mantell [*partim*], p. 113, Pl. 21, Fig. 9.
1964. *Mantelliceras callomoni* nov. sp.: Collignon. p. 99, Pl. 352, Fig. 1569.
1971. *Mantelliceras costatum* (Mantell); Kennedy, pp. 57—58, Pl. 19, Figs 1—2, and Pl. 24, Fig. 1 [*cum syn.*].
1976. *Mantelliceras costatum* (Mantell); Juignet & Kennedy, pp. 88—89, Pl. 13, Figs 1—2, Pl. 14, Fig. 4, and Pl. 17, Fig. 3 [*cum syn.*].
1976. *Mantelliceras costatum* (Mantell); Kennedy & Hancock, p. 37, Pl. 5, Fig. 5.
?1979. *Mantelliceras costatum* (Mantell, 1822); Immel, pp. 624—625, Pl. 2, Fig. 5.

Material: Two diagenetically compressed specimens, Nos *Tr 16* (Pl. 11, Fig. 2) and *Tr 18* (Pl. 11, Fig. 3).

Table 21

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 16	102.3	44	29	33	15	18
Tr 18	71.7	43	27	32	15	17

Remarks. — The investigated specimens (Pl. 11, Figs 2—3) are strongly ribbed and resemble in ornamentation the paralectotype of the species (*cf.* Kennedy 1971, p. 57, Pl. 19, Fig. 1). Their strong ribs make them different from the associated individuals of *Mantelliceras saxbii* (Sharpe) (*cf.* Pl. 9, Fig. 2).

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Mantelliceras costatum* (Mantell) has been reported from the Lower Cenomanian of England, France, and Madagascar.

Mantelliceras biroi Collignon, 1964
(Pl. 11, Fig. 4)

1964. ***Mantelliceras biroi*** **nov. sp.; Collignon, p. 84, Pl. 346, Figs 1540—1541, and Pl. 351, Fig. 1540.**
1972. ***Mantelliceras (Couloniceras) biroi*** **Collignon, 1964; Thomel, p. 27.**

Material: **Fragmentarily preserved specimen, No. *140.5230-2*.**

Description. — The whorls are flat-sided, much higher than broad (*Wb*: *Wh* = =0.80), with 11—12 long (primary) and 4—5 short (secondary) ribs per half whorl. The long ribs start at the umbilical edge. They are flexuous in outline, rather thin at the beginning, but widening upwards, especially in proximity of the latero-ventral shoulder, and passing at the venter. The secondaries start below the mid-flank, sometimes very close to the umbilical edge. Both the primaries and secondaries are very wide, almost contacting with one another in proximity of the latero-ventral shoulder (*cf.* Pl. 11, Fig. 4*a*), with rudimentary upper ventro-lateral tubercles. The absence of umbilical tubercles and the relatively wide umbilicus of the specimen under discussion indicate that this is an adult individual (*cf.* Collignon 1964, p. 84).

Remarks. — The wide ribs (an exception among representatives of the genus *Mantelliceras* Hyatt), the absence of umbilical, lateral, and lower ventro-lateral tubercles, and the reduction of upper ventro-lateral tubercles are entirely consistent with the diagnosis of the species *biroi* Collignon, and make the investigated specimen very close to those illustrated by Collignon (1964, Pl. 346, Fig. 1540, Pl. 351, Fig. 1540).

The species *Mantelliceras biroi* differs from its very close relative *M. agrawali* Collignon in its wider ribs and less numerous secondaries (Collignon 1964, p. 84).

Occurrence. — Lower Cenomanian (along with *Mantelliceras mantelli*), Rubas-chaj, Dagestan Caucasus (*cf.* Text-fig. 10).

The species *Mantelliceras biroi* Collignon has been reported from the Mantelliceras mantelli & Calycoceras newboldi Zone of the local stratigraphic division in Madagascar (Collignon 1964), which is equivalent to the Lower Cenomanian.

Mantelliceras ex gr. *dixoni* Spath, 1926
(Pl. 11, Fig. 5)

1969. ***Mantelliceras*** **gr.** ***dixoni*** **Spath; Kennedy, Pl. 16, Fig. 3.**
1971. ***Mantelliceras*** **gr.** ***dixoni*** **Spath; Kennedy, p. 59, Pl. 20, Figs 4—6, Pl. 21, Figs 3, 5, and Pl. 22, Fig. 2.**
1974. ***Mantelliceras*** **gr.** ***dixoni*** **Spath, 1926; Marcinowski, p. 175, Pl. 33, Fig. 5.**
1976. ***Mantelliceras*** **gr.** ***dixoni*** **Spath; Juignet & Kennedy, pp. 90—91, Pl. 20, Fig. 1.**

Material: **Three whorl fragments, Nos *119.14* (Pl. 11, Fig. 5), *130.2144-1*, and probably *127.4412*.**

Remarks. — Kennedy (1969, 1970, 1971) described under the name *Mantelliceras* gr. *dixoni* Spath specimens close to *M. dixoni* but different from the latter species in their tabulate venter and only weakly tuberculate inner whorls (there are strong umbilical, lower lateral, and ventro-lateral tubercles persistent up to 30 mm in shell diameter in *M. dixoni*). The investigated specimens are fragments of whorls exceeding 30 mm in diameter, non-tuberculate except for small umbilical tubercles at the primary ribs, with ribs attaining their maximum conspicuousness at the venter. Thus, they are consistent with the basic diagnostic characteristics of the species *dixoni* Spath. However, they are assigned to the group *"dixoni"* because of their flat venter. The only illustrated specimen (Pl. 11, Fig. 5) shows whorls almost square in cross section (*Wb*: *Wh*=0.95), ornamented with conspicuous but relatively sparsely spaced ribs. In turn, the specimen No. *130.2144-1* shows whorls much higher than broad (*Wb*: *Wh*=0.82), covered with much finer and more densely spaced ribs.

Occurrence. — Lower Cenomanian, MGU Station and southern slope of the Mt. Selbukhra, probably limestones of the Band *IV-1*, Crimea (*cf.* Text-fig. 6).

The species belonging to *Mantelliceras* gr. *dixoni* Spath have been reported from the Lower Cenomanian of England, France, and Poland; they seem to be characteristic of the upper Lower Cenomanian (Kennedy 1969, 1971). The latter supposition is corroborated by the present investigations, as strongly ornamented mantelliceratids like *M. mantelli* (*cf.* Pl. 10, Fig. 1) are confined to the base part of the Lower Cenomanian in the section at the Mt. Selbukhra, while more finely ornamented and especially less tuberculate mantelliceratid species, *M. picteti* and *M.* ex gr. *dixoni*, occur close to the Lower/Middle Cenomanian boundary (*cf.* Text-fig. 6).

Mantelliceras cantianum Spath, 1926
(Text-fig. 15 and Pl. 11, Fig. 6)

1857. *Ammonites navicularis*, Mantell; Sharpe [*partim*], pp. 39—40, Pl. 18, Figs 1—2.
?1871. *Ammonites Mantelli*, Sow.; Schlüter [*partim*], pp. 12—14, Pl. 5, Figs 3—4.
1926a. *Mantelliceras cantianum* nom. nov.; Spath, pp. 82—83.
1951. *Mantelliceras cantianum* Spath; Wright & Wright, p. 24.
1959b. *Mantelliceras cantianum Spath* [=*M. budaense* Adkins 1931]; Matsumoto, p. 71.
1964. *Mantelliceras cantianum* Spath; Collignon, p.80, Pl. 344, Fig. 1532.
1964. *Mantelliceras cantianum* Spath var. *unituberculata* nov. var.; Collignon, p. 80, Pl. 344, Fig. 1533.
1964. *Mantelliceras cantianum* Spath var. *abrupta* nov. var.; Collignon, p. 80, Pl. 344, Fig. 1534.
1969. *Mantelliceras cantianum* Spath; Matsumoto, Muramoto & Takahashi, pp. 256—258, Pl. 27, Fig. 3.
1969. *Mantelliceras* sp. aff. *M. cantianum* Spath; Matsumoto, Muramoto & Takahashi, p. 258, Pl. 28, Fig. 1.
1971. *Mantelliceras cantianum* Spath; Kennedy, pp. 85—87, Pl. 18, Fig. 1, Pl. 20, Fig. 1, Pl. 26, Figs 1 and 5.
1972. *Mantelliceras (Bunburyiceras) cantianum* Spath; Thomel, pp. 46—47, Pl. 14, Figs 1—2.
1972. *Mantelliceras (Bunburyiceras) moulinse* nov. sp.; Thomel, pp. 47—48, Pl. 14, Figs 3—5.
1976. *Mantelliceras cantianum* Spath; Juignet & Kennedy, pp. 87—88. Pl. 12, Figs 1, 4, Pl. 13, Fig. 4, Pl. 14; Fig 5, and ?Pl. 22, Fig. 3.
1976. *Mantelliceras cantianum* (Spath); Kennedy & Hancock, p. 37, Pl. 5, Figs 1—2.
1976. *Mantelliceras cantianum* (Spath); 1926; Young & Powell, p. 27, Pl. 7, Figs 10 and 12.

Material: Two specimens, Nos *Tr 20* (Pl. 11, Fig. 6) and W.M.-1 (Text-fig. 15).

Table 22

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 20	49.0	?45	51	35	?1.14	30	14	16
W.M.-1	80.0	39	47	31	1.18	36	18	18

Remarks. — The specimen No. *Tr 20* (Pl. 11, Fig. 6) shows whorls rounded in intercostal cross section, with prominent long and short ribs, especially at the venter. The long ribs bear umbilical tubercles and strongly developed, transversally elongate lower lateral tubercles (because of the poor preservation state, there are no tubercles at some ribs). In the outer part of the whorls the neighboring umbilical and lower lateral tubercles tend to fuse and produce a high and narrow rib. Upper ventro-lateral tubercles are very weakly developed and confined to the innermost part of the whorls, while lower ventro-lateral tubercles are lacking at all. The calycoceratiform ribbing makes the specimen under discussion close to one of those illustrated by Juignet & Kennedy (1976, Pl. 13, Fig. 4).

By the courtesy of Dr. C. Frieg (University of Münster) the present author has got a collection of Albian to Cenomanian ammonites from France and England. The collection includes a well preserved specimen of *Mantelliceras cantianum* Spath, No. *W.M.-1* (Text-fig.15). The specimen resembles most closely a form which, „deviates from the holotype in its more crowded ribs and less persistency of ventrolateral tubercles, but is essentially of *cantianum* type in its inflated and subrounded shell form and coarse ribbing. Provisionally it may be called *Mantelliceras* sp. aff. *M. cantianum,* but it could be an extreme variant of *M. cantianum*". (Matsumoto & *al.*, 1969, pp. 257—258, Pl. 28, Fig. 1). It is to be noted that the above quoted, elegant characteristic does not exceed the range of intraspecific variability of *M. cantianum.* In fact, the species under discussion includes specimens with umbilical, lower lateral, and lower and upper ventro-lateral tubercles persistent up to a great shell diameter (*cf.* Kennedy 1971, Pl. 18, Fig. 1; Thomel 1972, Pl. 14, Figs 1—2 and 5), as well as those with lower and upper ventro-lateral tubercles disappearing soon in ontogeny (*cf.* Text-fig. 15 and Pl. 11, Fig. 6; Matsumoto & *al.* 1969, Pl. 28, Fig. 1; Juignet & Kennedy 1976, Pl. 13, Fig. 4).

Occurrence. — No. *Tr 20:* Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2); No. *W.M.-1:* Lower Cenomanian Wissant by Boulonnais, France (middle part of M. mantelli Zone, unit *E*, bed *5* of Amedro & *al.* 1978).

The species *Mantelliceras cantianum* Spath shows a world-wide distribution, having been reported from the Lower Cenomanian of England, France, GFR and GDR, the Soviet Union (Kopet-Dag), Japan, Madagascar, and Western Interior of the United States.

Mantelliceras souaillonense (Renz, 1963)
(Pl. 12, Fig. 1)

1963. *Calycoceras souaillonense* n. sp.; Renz, pp. 1111—1112, Pl. 6, Fig. 1.
1966. *Calycoceras* aff. *souaillonense* Renz; Busnardo, p. 221, Pl. 13, Figs 3—4.
1971. *Mantelliceras* aff. *souaillonense* (Renz); Kennedy, pp. 59—60, Pl. 22, Fig. 1, and ?Pl. 22, Figs 2, 4.
1972. *Calycocreas (Gentoniceras) souaillonense* Renz, Luterbacher et Schneider; Thomel, p. 72.
1976. *Mantelliceras* aff. *souaillonense* (Renz); Kennedy & Hancock, p. 38, Pl. 8, Fig. 6.
1978. *Calycoceras (Gentoniceras) souaillonense* Renz; Renz & Jung, p. 16.

Material: One specimen, No. *Tr 19.*

Remarks. — The inner whorls are only a little higher than broad, with rounded intercostal cross section and coarse ribs (*cf.* Pl. 12, Fig. 1d-e). The long primaries start at the umbilical wall, bear an umbilical tubercle at the umbilical edge and a very prominent lower lateral tubercle a little higher up (this is the point where the maximum whorl breadth is attained). Beginning with the lower lateral tubercles, the ribs considerably incline backwards and extend across the venter, bearing also lower and upper ventro-lateral tubercles. The short secondaries start below the mid-flank; they show upper ventro-lateral tubercles and sometimes also lower ventro-lateral ones.

Table 23

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 19	28.7	40	41	30	1.03	$\left(\frac{1}{2}\right)$16	7	9
	77.3	39		29		$\left(\frac{1}{2}\right)$17	7	10

The upper and lower ventro-lateral tubercles disappear in ontogeny, whereas the lower lateral and umbilical tubercles become reduced to a swelling at the ribs (*cf.* Pl. 12, Fig. 1a-b). The long ribs alternate with short ribs, one or sometimes two secondaries per each two long ones. The short ribs may reach a proximity of the umbilical edge, and at the venter they are indistinguishable from the long ones.

The reduction of ribbing as well as of umbilical and lower lateral tubercles at the outer whorls makes the investigated specimen close to those described by Busnardo (1966, p. 221, Pl. 13, Figs 3—4) and Kennedy (1971, Pl. 22, Fig. 1) as a form aff. *souaillonense* Renz. One may claim that these differences from typical representatives of *Mantelliceras souaillonense* (Renz) fall within the range of intra-specific variability.

The preponderance of short over long ribs, the ovate whorl cross section, and the early disappearance of lower and upper ventro-lateral tubercles are those characteristics of the species *souaillonense* Renz resembling some representatives of the genus *Calycoceras* Hyatt. Nevertheless, the species under discussion cannot be assigned to the latter genus because there are no siphonal tubercles even at the inner whorls of its individuals (*cf.* Pl. 12, Fig. *1d-e*), while the absence of those tubercles throughout the ontogeny is among the main differences between *Mantelliceras* Hyatt and *Calycoceras* Hyatt.

Occurrence. — Lower Cenomanian, Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Mantelliceras souaillonense* (Renz) has been recorded in the upper Lower Cenomanian of Switzerland, England, and France.

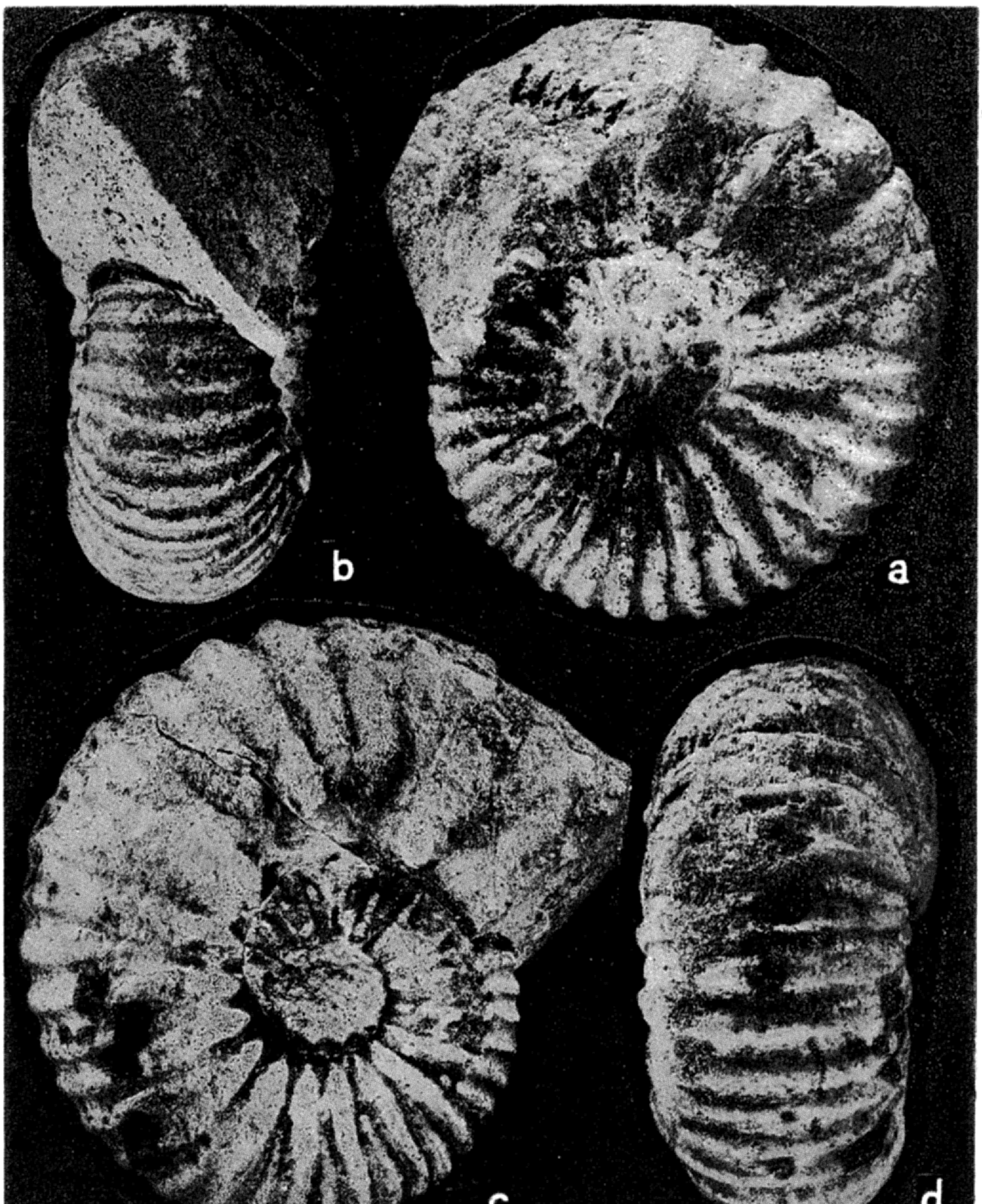
Mantelliceras sp. [close to *M. souaillonense* (Renz, 1963)] (Pl. 12, Fig. 2)

Material: Diagenetically compressed specimen, No. *Tr 13.*

Table 24

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 13	68.6	45	18	$\left(\frac{1}{2}\right)$15	6	9

Remarks. — The investigated specimen resembles in ornamentation the outer whorl of the above described one (*cf.* Pl. 12, Figs 2 and 1, respectively), while the differences consist in its much narrower umbilicus and more numerous short ribs.



Mantelliceras cantianum Spath; specimen No. *W.M.-1* in four views *(a-d)*; Lower Cenomanian, Wissant near Boulonnais, France; nat. size

The whorl cross section, rib outline at the venter, and ontogenetic change in tuberculation, which characteristics are distinctive of the species *souaillonense* Renz, cannot be recognized because of the poor preservation state.

Occurrence. — Lower Cenomanian, Hoppensted quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

So-called „Submantelliceratinae"

Remarks. — The investigated collection includes some specimens (Pl. 12, Figs 3—6) attributable to species known thus far exclusively after nuclei, *„Mantelliceras" aumalense* (Coquand) and *„M." suzannae* (Pervinquière), the generic position of which remains therefore unclear. The taxon *„M." aumalense* was recognized for the type species of *Submantelliceras* Spath, the genus having been diagnosed after its nucleus form shared with such genera as *Graysonites* Young or *Utaturiceras* Wright diagnosed in their turn after the adult shell (Matsumoto & Sarkar 1966, p. 306). Hence, the genus *Submantelliceras* is to be regarded as a *nomen dubium* (cf. Kennedy 1971, p. 53) until more completely preserved specimens are found. A more detailed discussion of the so-called „Submantelliceratinae", as well as differences between particular species are given by Matsumoto & Inoma (1975, pp. 281—284).

„Mantelliceras" aumalense (Coquand, 1862) (Pl. 12, Figs 3—4)

1907. *Acanthoceras Aumalense* Coquand; Pervinquière, pp. 296—298, Text-figs 112—114, Pl. 16, Figs 6—11.
1910. *Acanthoceras Aumalense* Coquand; Pervinquière, p. 42, Pl. 4, Figs 11—19.
1964. *Mantelliceras aumalense* Coq.; Collignon, p. 26, Pl. 323, Fig. 1435.

Material: Two specimens, *Nos I.Su.30* (Pl. 12, Fig. 3) and *I.Su.30a* (Pl. 12, Fig. 4).

Table 25

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R
I.Su.30	13.1	50	40	17	0.80	17
I.Su.30a	11.0	53	34	15	0.64	14

Remarks. — The investigated specimens do not significantly deviate from typical representatives of the species *aumalense* Coquand. The specimen No. *I.Su.30* (Pl. 12, Fig. 3) resembles most closely one of those described by Pervinquière (1907, Pl. 16, Fig. 11) and also the inner part of the specimen discussed by Collignon (1964, Pl. 323, Fig. 1435). The other specimen (Pl. 12, Fig. 4) is almost indistinguishable from another specimen of Pervinquière (1910, Pl. 4, Fig. 16).

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12).

The species *„Mantelliceras" aumalense* (Coquand) has been reported from the Lower Cenomanian of Tunisia, Algeria, and Madagascar.

"Mantelliceras" suzannae (Pervinquière, 1907) (Pl. 12, Figs 5—6)

1907. *Acanthoceras Suzannae* Pervinquière 1907; Pervinquière, pp. 298—300, Text-fig. 115, Pl. 16, Figs 12—13.

1910. *Acanthoceras Suzannae* Pervinquière; Pervinquière, p. 42, Pl. 4, Figs 30—31.
1964. *Mantelliceras suzannae* Perving.; Collignon, p. 27, Pl. 323, Fig. 1438.
1977. *Mantelliceras (Mantelliceras) suzannae* (Pervinquière); Kanie in Kanie, Hirano & Tanabe, p. 132, Pl. 2, Fig. 4.

Material: Four specimens, Nos *I.Su.2* (Pl. 12, Fig. 5), *I.Su.1* (Pl. 12, Fig. 6), *I.Su.3*, and *I.Su.4*.

Table 26

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R
I.Su.1	16.4	53	36	18	0.69	18
I.Su.2	11.4	53	33	21	0.63	16
I.Su.3	11.0	51	38	18	0.75	17
I.Su.4	11.0	48	38	18	0.79	17

Remarks. — The species *suzannae* Pervinquière differs from its close relative „*M.*" *aumalense* (Coquand) in its more compressed and rectangular whorl cross section and more prominent tubercles at the ventro-lateral shoulder.

Occurrence. — Lower Cenomanian, Sullu-kapy, *I* faunal horizon, Bands *3—4*, Mangyshlak (*cf.* Text-fig. 12).

The species „*Mantelliceras*" *suzannae* (Pervinquière) has been reported from the Lower Cenomanian of Tunisia, Algeria, and Madagascar.

Genus *ACOMPSOCERAS* Hyatt, 1903
(Type species: *Ammonites bochumensis* Schlüter, 1871)

Occurrence. — The genus *Acompsoceras* Hyatt occurs in the Lower to Middle Cenomanian of West Europe, northern Africa and Madagascar, and North America.

Acompsoceras renevieri (Sharpe, 1857)
(Pl. 13, Fig. 1)

1857. *Ammonites Renevieri*, Sharpe; Sharpe, p. 44, Pl. 20, Fig. 2.
1860. *Ammonites Renevieri*, Sharpe; Pictet & Campiche, p. 310.
1871. *Ammonites Bochumensis* sp. n.; Schlüter, pp. 1—2, Pl. 1, Figs 1—4, and Pl. 2, Fig. 1.
?1926b. *Acompsoceras* comparable to *A. bochumense* (Schlüter); Spath, p. 426.
?1951. *Acompsoceras* cf. *bochumense* (Schlüter); Wright & Wright, p. 27.
1951. *Acompsoceras renevieri* (Sharpe); Wright & Wright, p. 27.
1971. *Acompsoceras renevieri* (Sharpe); Kennedy, pp. 68—69, Pl. 30, Fig. 1.
1972. *Acompsoceras renevieri* (Sharpe); Thomel, p. 103.
?1972. *Acompsoceras* cf. *renevieri* (Sharpe); Thomel, p. 103.
1976. *Acompsoceras renevieri* Sharpe; Juignet & Kennedy, pp. 100—101, Pl. 11, Fig. 3.

Material: One specimen, No. *Tr 65*.

Remarks. — The investigated specimen (Pl. 13, Fig. 1) shows 11 wide and low umbilical tubercles per whorl at a diameter of 134 mm, passing into indistinct, short ribs reaching merely the mid-flank. There are long, clavate tubercles at the ventro-lateral shoulder, much more numerous than the umbilical ones (their number cannot be established because of the preservation state of the specimen). The

Table 27

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 65	134.0	48	?25	20	?0.51		11	
	103.5	48	23	21	0.47	(1/2)16	5	11
	42.7	46	23	26	0.50	ca19	10	9

venter is smooth, with a faint median ridge. This ornamentation is almost indistinguishable from that at the inner part of the last whorl of the specimen described and illustrated by Schlüter (1871, p. 1, Pl. 1, Figs 1—2). The inner whorls of the investigated specimen are less involute than the outer ones, and the ventro-lateral tubercles are there twice as numerous as the umbilical ones. At a diameter of 42.7 mm, there are 10 long primary ribs per whorl, with well developed umbilical and ventro-lateral tubercles, intercalated with short secondaries starting above the whorl mid-height and ending with ventro-lateral tubercles indistinguishable from those beared by the primaries.

The name *Ammonites bochumensis* Schlüter is a junior synonym of *Acompsoceras renevieri* (Sharpe). The difference in ornamentation reflects a difference in size of the forms under discussion (*cf.* Schlüter 1871, Pl. 1, Figs 1—2; and Kennedy 1971, Pl. 30, Fig. 1); in fact, the ornamentation declines in ontogeny in the species *renevieri Sharpe.* It is also to be noted that Schlüter himself regarded his species as a close relative of *Acompsoceras renevieri* (Sharpe), as he included Sharpe's specimen, although with some reservation, to the synonymy of his new species (*cf.* Schlüter 1871, p. 1).

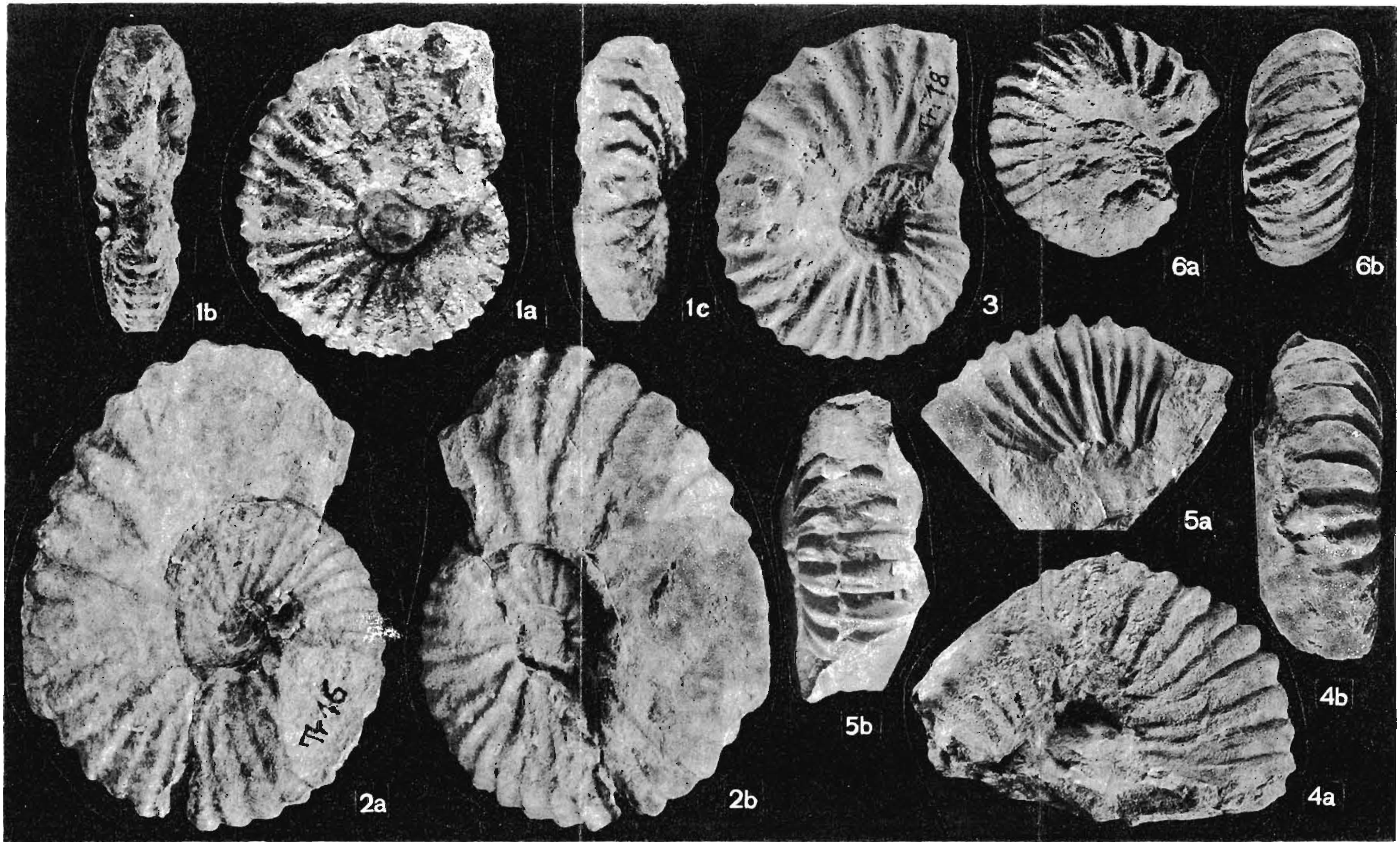
Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Acompsoceras renevieri* (Sharpe) has been recorded in the Lower to Middle Cenomanian of England, France, GFR and GDR.

Genus *CALYCOCERAS* Hyatt, 1900

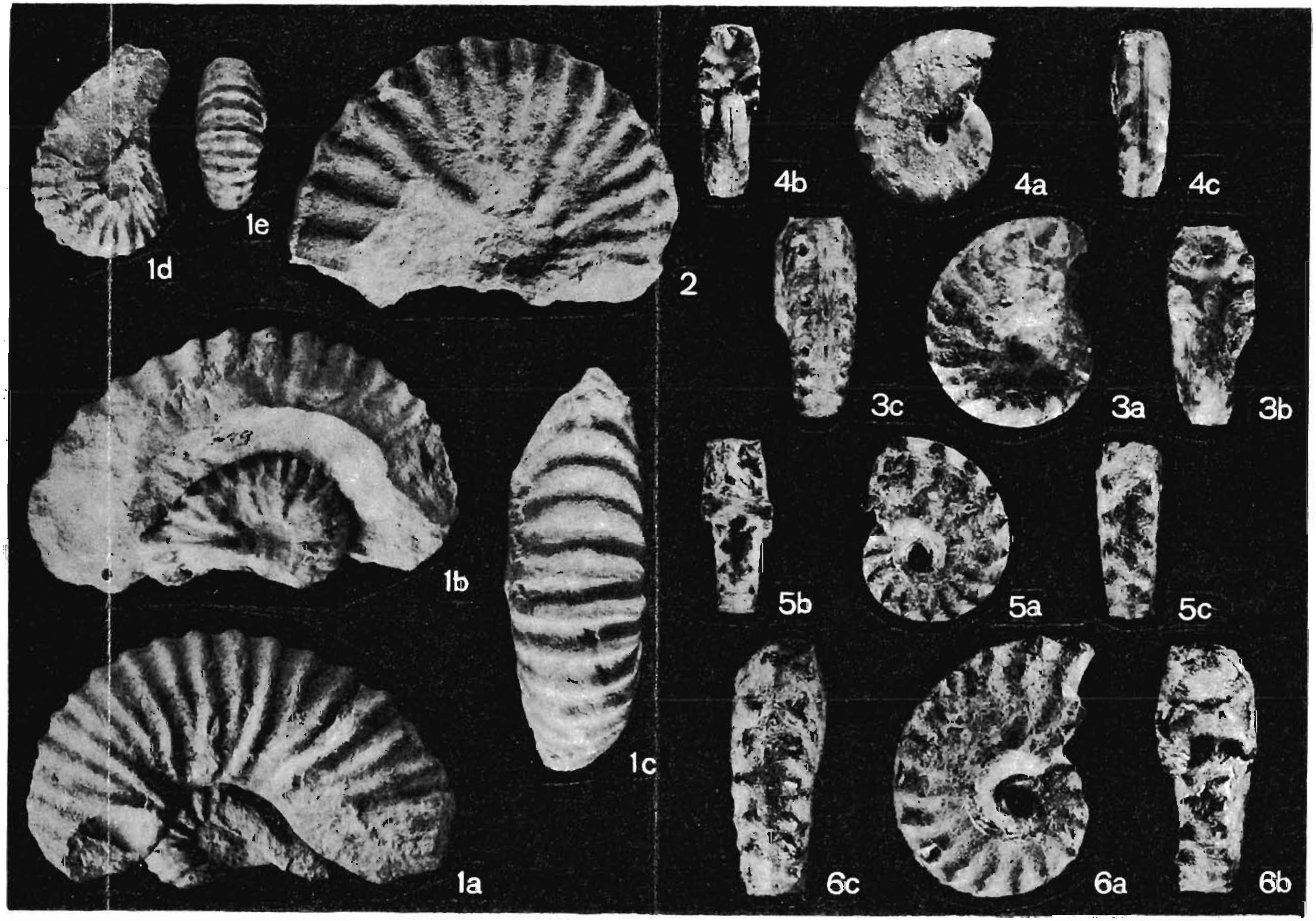
Remarks. — The genus *Calycoceras* Hyatt has been very widely diagnosed (*cf.* Matsumoto & al. 1957, pp. 8—9; Kennedy 1971, p. 70) and hence, it includes ammonite species widely variable in morphology. The ornamentation changes in ontogeny, which affects mostly the ribbing and tuberculation, hampering recognition of true relationships among the species of *Calycoceras* that commonly have been established after phragmocones or juvenile shells. Consequently, some authors used to recognize within the genus *Calycoceras* various groups of species, while postponing a formal introduction of subgenera until the mutual interrelationships among species groups will be determined (*cf.* Matsumoto & *al.* 1957, p. 9; Kennedy 1971, p. 70; Juignet & Kennedy 1976, pp. 103—104), or they accept only a few well known subgenera (*cf.* Kennedy 1971, p. 78; Marcinowski 1974, p. 177; Matsumoto 1975, p. 102). In contrast, other authors (Wiedmann 1959, 1964a; Cobban & Scott 1972; Thomel 1972) have proposed various subgenera of the genus *Calycoceras.* The present author shares the opinion of Cooper (1978, p. 85) that the following subgenera can be distinguished at the present state of the knowledge of the considered genus: the nominative subgenus *Calycoceras* Hyatt and *Lotzeites* Wiedmann, *Conlinoceras* Cobban & Scott, *Newboldiceras* Thomel, and *Gentoniceras* Thomel.

The investigated collection includes representatives of the subgenera *Calycoceras, Newboldiceras,* and *Lotzeites,* the latter subgenus having been discussed in an earlier paper (Marcinowski 1974, p. 177).



Mantelliceras tenue Spath: 1 — specimen No. P.H.M.2, Lower Cenomanian, Podzametschek near Butschatsch. **Mantelliceras costatum** (Mantell): 2 — specimen No. Tr 16, 3 — No. Tr 18 (cast); Lower Cenomanian, Hoppenstedt. **Mantelliceras biroi** Collignon: 4 — specimen No. 140.5230-2, Lower Cenomanian, Rubas-chaj. **Mantelliceras** ex gr. **dixoni** Spath: 5 — specimen No. 119.14, Lower Cenomanian, Mt. Selbukhra, Band IV-1. **Mantelliceras cantianum** Spath: 6 — specimen No. Tr 20 (cast), Lower Cenomanian, Hoppenstedt

All figures in natural size



Mantelliceras souaillonense (Renz): 1 — specimen No. Tr 19, Lower Cenomanian, Hoppenstedt. **Mantelliceras** sp. close to *M. souaillonense* (Renz): 2 — specimen No. Tr 13, Lower Cenomanian, Hoppenstedt. "**Mantelliceras**" **aumalense** (Coquand): 3 — specimen No. I.Su.30, 4 — No. I.Su.30a; Lower Cenomanian, Sullu-kapy, Bands 3—4 (*I* faunal horizon). "**Mantelliceras**" **surannae** (Pervinquière): 5 — specimen No. I.Su.2, 6 — No. I.Su.1; Lower Cenomanian, Sullu-kapy, Bands 3—4 (*I* faunal horizon)
Figs 1—2 in natural size, the others × 3

Occurrence. — The genus *Calycoceras* Hyatt shows a world-wide distribution, having been recorded in the Middle to Upper Cenomanian of Europe, Africa, Asia, Australia, and North America.

Subgenus *CALYCOCERAS* Hyatt, 1900
(Type species: *Ammonites navicularis* Mantell; 1822)
Calycoceras (Calycoceras) naviculare (Mantell, 1822)
(Pl. 14, Figs 1—2)

1822. *Ammonites navicularis;* Mantell, p. 198, Pl. 22, Fig. 5.
1871—1875. *Ammonites Mantelli* Sow.; Geinitz, p. 279, Pl. 62, Fig. 1.
1898. *Acanthoceras naviculare* (Mantell); Choffat, p. 72, Pl. 4, Fig. 6, and Pl. 6, Figs 1—2.
1926a. *Metacalycoceras naviculare;* Spath [*partim*], p. 83.
1926b. *Metacalycoceras grossouvrei,* nom. nov.; Spath, p. 431.
1931. *Metacalycoceras („Acanthoceras") borgesi* Douvillé; Spath, p. 316.
1935. *Acanthoceras (Calycoceras) naviculare* Mantell 1822; Karrenberg, pp. 129—130, Text-fig. 1.
1935. *Acanthoceras (Calycoceras) naviculare* Mantell 1822; Karrenberg, pp. 129—130, Text-fig. 1.
non 1935. *Acanthoceras (Calycoceras) naviculare* Mant. var. *multicostata* nov. var.; Karrenberg, pp. 130—131, Pl. 30, Fig. 1 [?= a Middle Cenomanian representative of *Calycoceras*].
1937. *Calycoceras* cf. *stoliczkai* Collignon; Matsumoto, Saito & Fukada, pp. 19—20, Pl. 6, Fig. 1.
1958. *Calycoceras (Metacalycoceras) auspicium* Anderson n. sp.; Anderson [*partim*], pp. 243—244, Pl. 20, Fig. 8.
1958. *Mantelliceras oregonense* Anderson n. sp.; Anderson, p. 244, Pl. 8, Fig. 4, and Pl. 14, Fig. 1.
1959b. *Calycoceras stoliczkai* Collignon; Matsumoto, pp. 78—81, Text-figs 33—35, Pl. 21, Fig. 1.
1965. *Calycoceras grossouvrei* Spath; Collignon, pp. 172—173, Pl. B, Fig. 2.
1969. *Calycoceras naviculare* (Mantell); Kennedy, p. 546, Pl. 21.
1971. *Calycoceras naviculare* (Mantell); Kennedy, pp. 71—74, Pl. 33, Fig. 1, Pl. 34, Fig. 1, Pl. 35, Fig. 1, Pl. 36, Figs 1—4, Pl. 37, Figs 1—3, and Pl. 47, Figs 1, 3, 5 [*cum syn.*].
1971. *Calycoceras naviculare* (Mantell); Cobban, pp. 13—18, Text-figs 12—14, Pl. 1, Figs 1—3, Pl. 10, Figs 1—8, Pl. 11, Figs 1—5, Pl. 12, Figs 1—2, Pl. 13, Figs 1—5, Pl. 14, Figs 1—3, Pl. 15, Figs 1—2, Pl. 16, Figs 1—2, and Pl. 17 [*cum syn.*].
1972. *Calycoceras* cf. *C. naviculare* (Mantell); Cobban & Scott, p. 60, Pl. 21, Figs 1 and 3—4.
1973. *Calycoceras naviculare* (Mantell); Wright & Kennedy *in* Juignet, Kennedy & Wright, pp. 228—229, Text-fig. 7, Pl. 1, Fig. 1.
1975. *Calycoceras* cf. *C. naviculare* (Mantell); Hattin, p. 54, Pl. 6, Fig. L.
1975. *Calycoceras* sp. cf. *C. naviculare* (Mantell); Matsumoto, pp. 102—103, Text-fig. 1.
1976. *Calycoceras naviculare* (Mantell); Juignet & Kennedy, pp. 106—107, Pl. 24, Fig. 2, and Pl. 28, Fig. 1 [*cum syn.*].
1976. *Calycoceras naviculare* (Mantell); Kennedy & Hancock, p. 40, Pl. 14, Fig. 2.
1977. *Calycoceras naviculare* (Mantell); Kauffman, p. 248, Pl. 16, Fig. 6.
1978. *Calycoceras (Calycoceras) naviculare* (Mantell, 1822); Cooper, pp. 85—89, Text-figs 4L-M, 12A, 15A, 17A-B, and 18A-B.

Material: Two specimens, Nos *Tr 62* (Pl. 14, Fig. 1) and *Tr 12/382* (Pl. 14, Fig. 2).

Table 28

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 62	160.0	44	?41	31	?0.93	ca 30	15	15
Tr 12/382	95.0	40	51	27	1.28	(3/4)27	13	14
Geinitz (1875 Pl.62, Fig.1)	171.5	41	46	30	1.13	31	15	16
	125.0	39	45	30	1.15			

Remarks. — The specimen No. *Tr 62* (Pl. 14, Fig. 1) resembles very closely some sparsely ribbed, slender individuals of *Calycoceras (C.) naviculare* (Mantell), with whorls higher than broad in intercostal cross section (*cf.* Cobban 1971, Text-fig. 13A and Pl. 15, Figs 1—2).

In turn, the specimen No. *Tr 12/382* (Pl. 14, Fig. 2) resembles in ribbing and whorl cross section the form *Calycoceras grossouvrei* (Spath) (*cf.* Collignon 1965, Pl. B, Fig. 2; Thomel 1972, Pl. 17, Figs 6—7) which is a junior synonym of *Calycoceras (C.) naviculare* (cf. Juignet & Kennedy 1976, p. 106). It differs from the above cited specimens in its narrower whorl cross section (*Wb* : *Wh*=1.28, while it attains 1.38 in Collignon's specimen), but it seems to be consistent with the diagnosis of the species *naviculare* Mantell when the considerable intraspecific variability of that species is taken into account (*cf.* Cobban 1971, Kennedy 1971, Juignet & Kennedy 1976).

The specimen described by Geinitz (1871—1875, p. 279, Pl. 62, Fig. 1) under the name of *Ammonites Mantelli* Sow. is actually representative of *Calycoceras (C.) naviculare*, and its ornamentation resembles very closely that observed in the specimen No. *Tr 62*. By the courtesy of Dozänt H. P. Prescher, the present author was able to investigate Geinitz's specimen stored in the Staatliches Museum für Mineralogie und Geologie at Dresden. Its primary ribs start at the umbilical edge, and the secondaries a little above the edge. All the ribs are equally distinct at the venter. The whorls are moderately narrow in cross section.

The maximum whorl breadth is at the umbilical tubercles in *Acanthoceras (Calycoceras) naviculare* var. *multicostata* of Karrenberg (1935, p. 130, Pl. 30, Fig. 1) which assures the correctness of its assignment to the genus *Calycoceras* (cf. Wright *in* Kennedy 1971, p. 50) and hence, allows to refute any supposition of the Early Cenomanian age of deposits containing this form (*cf.* Karrenberg 1935, pp. 131 and 155; *see* also remarks on „*Metoicoceras*" *antiquum* in Cooper 1978, p. 117). The specimen under discussion is rather finely ribbed which resembles the Middle Cenomanian species *Calycoceras boulei* Collignon and especially *C. multicostatum* Collignon, but it differs from both the species in its much broader whorl cross section (*cf.* Collignon 1964, p. 126, Pl. 375, Figs 1594—1595). By the way, a dense ribbing recognized by Karrenberg (1935, p. 130) for diagnostic of his new variety *multicostata* appears insignificant, because the species *Calycoceras (C.) naviculare* includes forms with over 40 ribs per whorl at a diameter of 90—100 mm, *i.e.* at a stage comparable to that of Karrenberg's specimen (*cf.* Cobban 1971, p. 18, Text-fig. 12B).

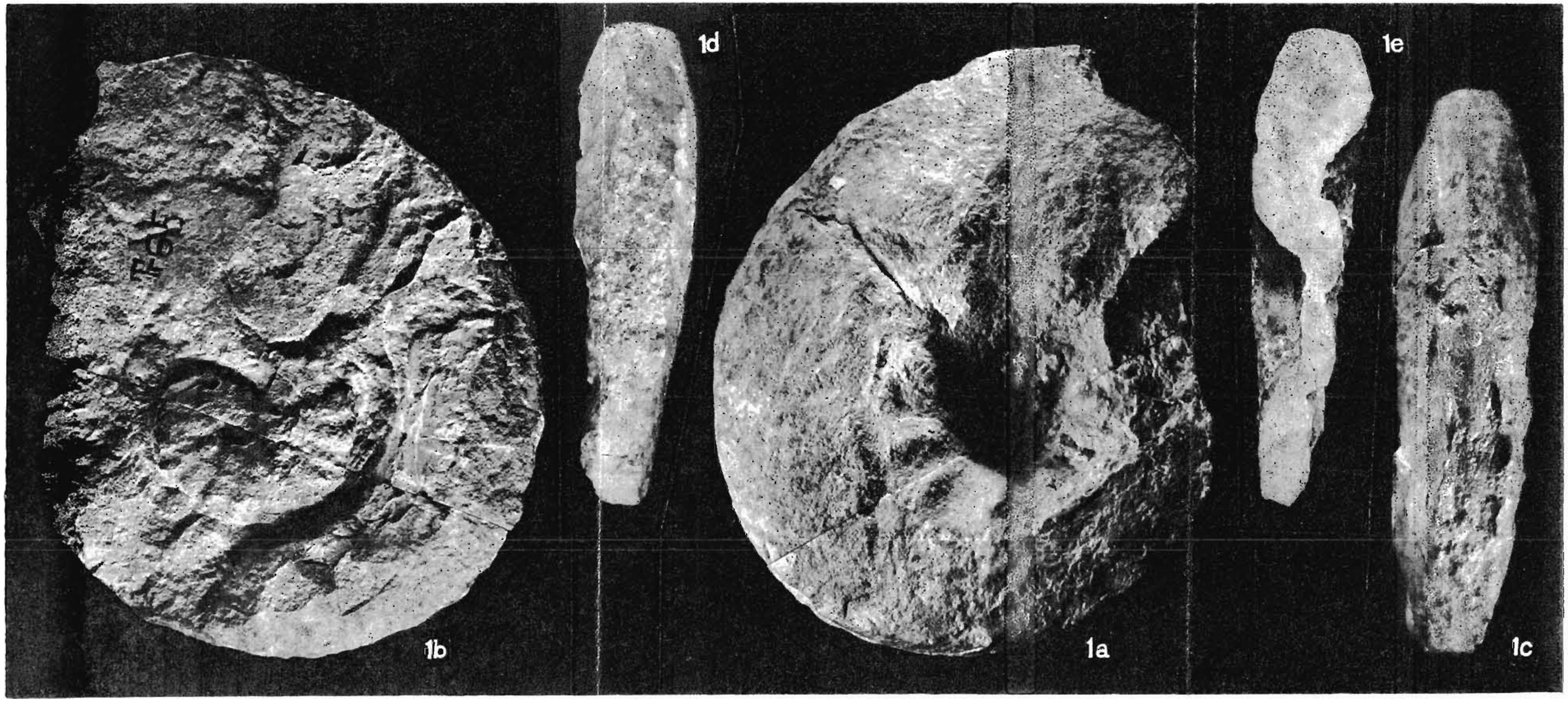
Occurrence. — No. *Tr 62:* Upper Cenomanian (Unterquader), Goldene Höhe by Bannewitz, Saxony; No. *Tr 12/382:* Upper Cenomanian (Unterquader), Ehrlicht by Freiberg, Saxony.

The species *Calycoceras (C.) naviculare* (Mantell) shows a world-wide distribution, having been reported from the Upper Cenomanian of Europe (England, France, Portugal, Spain, and GDR), Africa (Tunisia, Algeria, Angola) and Madagascar, Asia (southern India, Japan), Australia, and Western Interior of the United States.

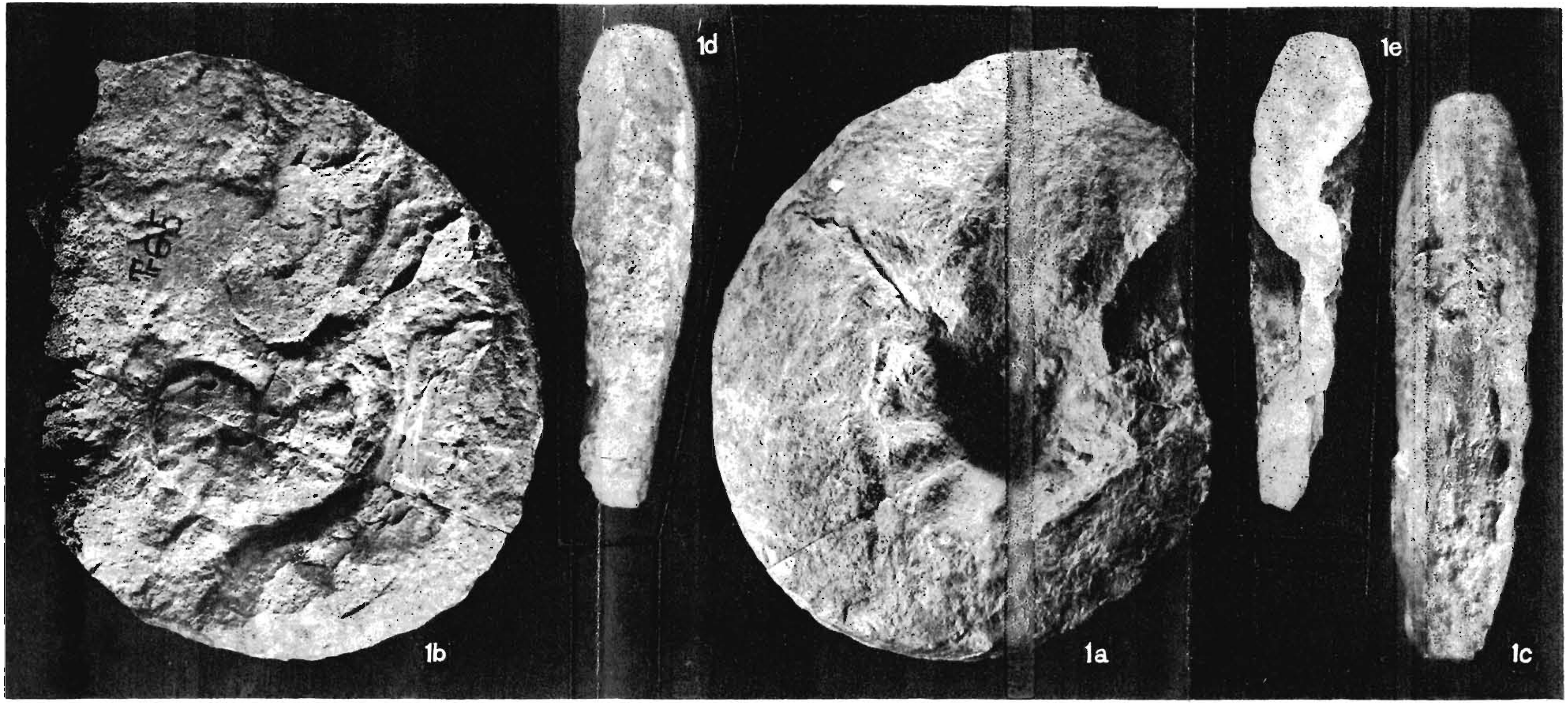
Calycoceras (Calycoceras) ex gr. *naviculare* (Mantell, 1822)
(Pl. 14, Fig. 3)

Material: **Fragment of a large-sized whorl, No. *Tr 63*.**

Description. — The whorl bears very coarse and strong long and short ribs. The long ribs start at the umbilical wall and shows a transversally elongate umbilical bulla in proximity of the umbilical edge. Higher up, the ribs become



Acompsoceras renevieri (Sharpe): **1** — specimen No. Tr 65, Middle Cenomanian. Hoppenstedt, beds with *Acanthoceras*, × 1



Acompsoceras renevieri (Sharpe): **1** — specimen No. Tr 65, Middle Cenomanian. Hoppenstedt, beds with *Acanthoceras*, × 1 wider, producing something like a rudimentary tubercle close to the latero-ventral shoulder, and attain their maximum conspicuousness at the venter where they display upper ventro-lateral tubercles. The secondary ribs are onset a little above the umbilical edge. Initially, they are fine but they rapidly widen and become indistinguishable from the primaries already below the whorl mid-height. The ribs are widely spaced, narrower than the interspaces. The umbilical wall seems to be low and gentle, but this feature cannot be recognized with certainty because of the poor preservation state.

Remarks. — The coarse and strong ribbing with alternating long and short ribs indicates that the investigated specimen (Pl. 14, Fig. 3) is a fragment of a large-sized shell attributable to *Calycoceras (C.) naviculare* (Mantell). However, the poor development of umbilical tubercles, sparse ribbing, and low umbilical wall make a resemblance to some Middle Cenomanian representatives of the subgenus *Conlinoceras* (cf. Cobban & Scott 1972, p. 61, Pl. 2, Figs 8, 15, and Pl. 3, Figs 7, 11). Consequently, the specimen cannot be identified with certainty.

Occurrence. — Lower Upper Cenomanian (Unterquader), along with *Calycoceras (Newboldiceras) newboldi newboldi*, Niederschöna by Freiberg, Saxony.

Subgenus *NEWBOLDICERAS* Thomel, 1972
(Type species: *Acanthoceras newboldi* Kossmat, 1897)

Remarks. — The subgenus *Newboldiceras* Thomel includes forms showing characteristics indicative of the genus *Acanthoceras* Neumayr, as well as of *Calycoceras* Hyatt. In contrast to most representatives of the latter genus, the lower and upper ventro-lateral and umbilical tubercles persist up to the outermost whorl of the adult shell, and the umbilicus is wide in *Newboldiceras* Thomel (*cf.* Thomel 1972, p. 165). The tuberculation may a little decline at the outer whorls of large-sized, adult individuals of *Newboldiceras* (cf. Pl. 15, Fig. 1; Thomel 1972, Pls 38 and 41). Primary ribs predominate in large-sized *Newboldiceras*, with intercalar ribs occurring only sporadically; whereas short and long ribs alternate, or even short ones prevail in representatives of the subgenus *Calycoceras*.

The subgenus *Pseudacanthoceras* was distinguished by Thomel (1972, p. 153) within the genus *Acanthoceras* Neumayr, with *Acanthoceras tapara* Wright, 1963, being its type species. That species is characterized by densely spaced ribs more and more prominent in ontogeny, lower and upper ventro-lateral tubercles persistent up to a considerable shell size, and whorls more and more rounded in cross section in ontogeny. Because of these characteristics, the species *A. tapara* is transitional between *Acanthoceras* and *Calycoceras newboldi* group (*cf.* Wright 1963, p. 605). Hence, *A. tapara* is to be attributed to *Newboldiceras* Thomel, and *Pseudacanthoceras* Thomel is to be recognized for a junior synonym of that subgenus (Marcinowski 1979, p. 60). Some specimens attributed by Thomel (1972) to *Pseudacanthoceras* actually belong to the nominative subgenus *Acanthoceras* Neumayr (*cf.* synonymy of *Acanthoceras (A.) rhotomagense subflexuosum* Spath; and Juignet & Kennedy 1976, pp. 116—117).

Occurrence. — The subgenus *Newboldiceras* Thomel occurs in the Middle to lower Upper Cenomanian of Europe, Asia, Africa, Australia, and North America.

Calycoceras (Newboldiceras) newboldi newboldi (Kossmat, 1898)
(Pl. 15, Fig. 1)

1898. *Acanthoceras Newboldi* n. sp. (Typische Form); Kossmat, pp. 112—114, Text-fig. 1, Pl. 12, Figs 2—3, and Pl. 14, Fig. 2.
1907. *Acanthoceras Newboldi* Kossmat; Pervinquière, pp. 264—265, Pl. 13, Fig. 1.
1951. *Calycoceras newboldi* (Kossmat); Wright & Wright, p. 25.
1958. *Calycoceras (Eucalycoceras) newboldi* (Kossmat); Anderson, pp. 242—243, Pl. 7, Fig. 1.
1959. *Calycoceras newboldi* (Kossmat); Hancock, p. 250.
1962. *Calycoceras newboldi* (Kossmat); Avnimélech & Shoresh, p. 533.
1964. *Calycoceras newboldi* Kossmat; Collignon, p. 120, Pl. 362, Fig. 1585.
1971. *Calycoceras newboldi newboldi* (Kossmat); Kennedy, pp. 75—76, Pl. 40, Fig. 2.
1971. *Calycoceras* aff. *newboldi newboldi* (Kossmat); Kennedy, Pl. 39, Fig. 2.

1972. *Newboldiceras (Newboldiceras) newboldi* (Kossmat); Thomel, pp. 106—109, Pl. 34, Figs 1—3, Pl. 38, Figs 1—2, Pl. 39, Figs 1—3, Pl. 40, Figs 1—3, Pl. 41, and Pl. 42, Figs 3—4.
1976. *Calycoceras newboldi* (Kossmat): Chao King-koo, pp. 543—544, Pl. 18, Figs 22—23.

Material: One specimen, No. *Tr* 61.

Table 29

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 61	235	39	36	$\left(\frac{3}{4}\right)$20	20	0

Remarks. — The investigated specimen (Pl. 15, Fig. 1) is diagenetically flattened and hence, its whorl cross section cannot be determined with certainty. However, its ornamentation and shell proportions make it close to that one presented by Thomel (1972, p. 108, Pl. 38, Figs 1—2), the difference consisting in the ribs being more numerous in the latter specimen. It is to be noted that the rib density decreases with shell diameter in the subspecies *newboldi* Kossmat; the above cited Thomel's specimen bears 31—32 ribs per whorl at a diameter of 185 mm, the author's specimen bears c. 27 ribs per whorl (20 per three fourth of whorl) at a diameter of 235 mm, and another Thomel's (1972, Pl. 41) specimen bears 27 ribs per whorl at 260 mm in diameter.

Occurrence. — Lower Upper Cenomanian (Unterquader), along with *Calycoceras (Calycoceras)* ex gr. *naviculare* (Mantell), Niederschöna by Freiberg, Saxony.

The subspecies *Calycoceras (Newboldiceras) newboldi newboldi* (Kossmat) has been reported from the Middle to Upper Cenomanian of England, France, Tunisia, Israel, India, China (the Himalayas), Madagascar, and Western Interior of the United States.

Calycoceras (Newboldiceras) spinosum nodosum (Thomel, 1972) (Pl. 16, Fig. 1)

1972. *Newboldiceras (Newboldiceras) spinosum nodosum* nov. subsp.; Thomel, pp. 112—113, Pl. 37, Fig. 4.

Material: One specimen, No. *Tr* 53.

Table 30

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 53	?210	?38	?36	?33	?0.94	$\left(\frac{1}{2}\right)$14	13	1

Remarks. — The investigated specimen (Pl. 16, Fig. 1) shows prominent, rounded lower and upper ventro-lateral tubercles (nodes) and almost exclusively singular, rursiradiate primary ribs, which characteristics are diagnostic of the subspecies *nodosum* Thomel (*cf*. Thomel 1972, pp. 112—113, Pl. 37, Fig. 4).

The subspecies *Calycoceras (N.) spinosum nodosum* differs from *Calycoceras (N.) spinosum spinosum* (Kossmat) in its whorls being higher than broad at a large shell diameter, as well as in the shape of its lower and upper ventro-lateral tubercles and much smaller number of secondary ribs (*cf.* Kossmat 1898, Pl. 2, Figs 2—3; Pervinquière 1907, Pl. 13, Figs 2—3; Matsumoto & *al.* 1957, Text-fig. 3 and Pls 3—4; Collignon 1964, Pl. 362, Fig. 1586, and Pl. 363, Fig. 1589; Kennedy 1971, Pl. 42, Fig. 1; Thomel 1972, Pl. 42, Figs 1—2, and Pl. 46, Figs 1—3; Pop & Szasz 1973, Pl. 6, Fig. 1).

The considered subspecies resembles in ornamentation and whorl cross section the subspecies *Calycoceras (N.) newboldi vectensiforme* (Thomel) but the latter subspecies shows more densely spaced ribs and weaker umbilical and lower and upper ventro-lateral tubercles. Consequently, the ribs between umbilical and lower ventro-lateral tubercles are weaker in the subspecies *nodosum* Thomel than in *vectensiforme* Thomel (*cf.* Thomel 1972, Pl. 37, Fig. 4 and Pls 44—45, respectively).

Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The subspecies *Calycoceras (Newboldiceras) spinosum nodosum* (Thomel) has been reported from the Middle Cenomanian of the French Subalpine Chain (base of the Zone *4* of Thomel 1972).

Subfamily **Acanthoceratinae** Hyatt, 1900
Genus *ACANTHOCERAS* Neumayr, 1875

Remarks. — In the investigated collection the genus *Acanthoceras* Neumayr is represented by specimens attributable to the following subgenera: the nominative subgenus *Acanthoceras* Neumayr, *Guerangericeras* Thomel, and *Alternacanthoceras* Marcinowski. These subgenera were discussed, and the species *Acanthoceras (Alternacanthoceras) jukesbrownei* (Spath) was described in an earlier paper (Marcinowski 1979).

Subgenus *ACANTHOCERAS* Neumayr, 1875
(Type species: *Ammonites rhotomagensis* Brongniart *in* Cuvier & Brongniart, 1822)
Acanthoceras (Acanthoceras) rhotomagense rhotomagense (Brongniart, 1822)
(Pl. 17, Fig. 1, and Pl. 18, Figs 1—2)

1822. *Ammonites rhotomagensis*, Defr.; Brongniart, p. 391, Pl. 6, Fig. 2.
1956. *Acanthoceras chasca*, new species; Benavides-Cáceres, pp. 466—467, Text-fig. 48, Pl. 53, Figs 1—4.
1970. *Acanthoceras rhotomagense* (Brongniart 1822) forma typica; Kennedy & Hancock, pp. 466—469, Text-figs 2, 6b, and 7, Pl. 88, Figs 1—5, Pl. 89, Fig. 1 [*cum syn.*].
1971. *Acanthoceras rhotomagense rhotomagense* (Brongniart); Kennedy, p. 86.
1976. *Acanthoceras rhotomagense rhotomagense* (Brongniart); Juignet & Kennedy, p. 115, Pl. 29, Figs 1—2 [*cum syn.*].

Material: Three diagenetically compressed specimens, Nos *Tr 57* (Pl. 17, Fig. 1), *Tr 59* (Pl. 18, Fig. 1), and *Tr 52* (Pl. 18, Fig. 2).

Remarks. — The outermost part of the specimen No. *Tr 52* (Pl. 18, Fig. 2) probably presents a fragment of the body chamber, as there are no septa and the shell is filled up with echinoids, brachiopods, and other large-sized fossil remains. Presumably, the phragmocone ends at a diameter of some 200 mm, as the shell evoluteness increases at greater diameters just as it is the case in other large-sized, adult individuals of *Acanthoceras (Acanthoceras) rhotomagense rhotomagense* (Brongniart) (*cf.* Kennedy & Hancock 1970, p. 467).

The outer whorl of the specimen No. *Tr 57* (Pl. 17, Fig. 1) is ornamented mostly with singular, rectiradiate ribs, whereas intercalar ribs (3—4 in number) occur only in the inner whorls, at less than 100 mm in diameter. That specimen,

Table 31

Specimen No.	D mm	Wh %	Wb %	U %	Wb/Wh	R	Rp	Rs
Tr 52	249.3	40		36		22	22	0
	188.0	40		34		22	22	0
	167.6	37		32		ca22	22	0
Tr 57	157.5	37		36		25	21-22	3-4
Tr 59	122.3	41	?31	33	?0.77	26	26	0

as well as the specimen No. *Tr 59* (Pl. 18, Fig. 1), is densely ribbed which makes an affinity to *Acanthoceras (A.) rhotomagense subflexuosum* (Spath). The two considered specimens differ from the latter subspecies in their stronger tuberculation and the absence of flexuous ribs.

Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The subspecies *Acanthoceras (A.) rhotomagense rhotomagense* (Brongniart) has been reported from the Middle Cenomanian of England, France, and the Venezuelan Andes.

Acanthoceras (Acanthoceras) rhotomagense subflexuosum Spath, 1923 (Pl. 19, Fig. 1)

1951. *Acanthoceras subflexuosum* Spath; Wright & Wright, p. 28.
?1964. *Acanthoceras rotomagense* Brgt.; Collignon, p. 144, Pl. 372, Fig. 1618.
1970. *Acanthoceras rhotomagense* var. *subflexuosum* Spath 1923; Kennedy & Hancock, pp. 469—472, Text-fig. 8, Pl. 90, Figs 1 and 3—4 [*cum syn.*].
?1970. *Acanthoceras rhotomagense* aff. var. *subflexuosum* Spath; Kennedy & Hancock, p. 472, Pl. 90, Fig. 2.
1971. *Acanthoceras rhotomagense subflexuosum* Spath; Kennedy, p. 86.
?1972. *A. rotomagense collignoni* nov. subsp.; Thomel, p. 130.
1972. *Acanthoceras (Acanthoceras) rotomagense* var. *subflexuosum* Spath; Thomel, pp. 134—135, Pl. 56, Figs 6—8 and 9.
1972. *Acanthoceras (Pseudacanthoceras) villoutreysi* nov. sp.; Thomel, pp. 154—155, Pl. 52, Figs 1—2, and Pl. 53, Figs 1—2.
1972. *Acanthoceras (Pseudacanthoceras) scaphitoides* nov. sp.; Thomel, p. 155, Pl. 52, Figs. 3—4.
1976. *Acanthoceras rhotomagense subflexuosum* Spath, 1923; Juignet & Kennedy, pp. 115—116, Pl. 31, Fig. 1 [*cum. syn.*].

Material: Diagenetically compressed specimen, No. *Tr 58*.

Table 32

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 58	200.7	38	38	27	27	0
	139.7	40	31	$(\frac{1}{2})$15	15	0

Remarks. — The investigated specimen (Pl. 19, Fig. 1) resembles very closely *Acanthoceras (A.) rhotomagense subflexuosum* Spath (cf. Kennedy & Hancock 1970, Text-fig. 8); in fact, the flatness and wideness of its ribs are an artifact of its diagenetic deformation.

The specimen described by Collignon (1964, p. 144, Pl. 372, Fig. 1618) and designated by Thomel (1972, p. 130) for the holotype of the new subspecies *collignoni* Thomel shows somewhat flexuous, densely spaced (32 per whorl) ribs and rather inconspicuous tubercles. These characteristics indicate that Thomel's subspecies is synonymous, or at least very closely related to *Acanthoceras (A.) rhotomagense subflexuosum*. Actually, the only difference is in the whorls being much broader in the former form.

Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The subsepcies *Acanthoceras (A.) rhotomagense subflexuosum* Spath has been reported from the Middle Cenomanian of England, France, and possibly Madagascar.

Acanthoceras (Acanthoceras) rhotomagense cf. *subflexuosum* Spath, 1923 (Pl. 18, Fig. 3)

Material: Diagenetically compressed phragmocone fragment, No. 136.32a.

Remarks. — The fine ornamentation and densely spaced, somewhat flexuous ribs make the investigated specimen (Pl. 18, Fig. 3) close to the subspecies *subflexuosum* Spath. However, the specimen is too fragmentary to be identified with certainty.

Occurrence. — Middle Cenomanian, Ajmaki, Dagestan Caucasus (*cf.* Text--fig. 9).

Acanthoceras (Acanthoceras) rhotomagense sussexiense (Mantell, 1822) (Pl. 19, Fig. 2, and Pl. 20, Figs 1—2)

1822. *Ammonites Sussexiensis*; Mantell, pp. 114—115, Pl. 20, Fig. 2.
1854. *Ammonites Rhotomagensis*, Defrance; Sharpe, pp. 33—34, Pl. 16, Figs 1 and 3 [Fig. 2 = = a form transitional to *Acanthoceras (A.) rhotomagense rhotomagense*, according to Kennedy & Hancock 1970, p. 472].
non 1854. *Ammonites Sussexiensis*, Mantell; Sharpe, p. 34, Pl. 15, Fig. 1 [= *Euomphaloceras inerme*, according to Kennedy & Hancock 1970, p. 473].
1863. *Ammonites rotomagensis*, Al. Brongniart; Pictet [*partim*], pp. 25—28, Pl. 2, Fig. 1.
1926a. *Acanthoceras vectense* nom. nov.; Spath, p. 82.
1951. *Acanthoceras vectense* Spath; Wright & Wright, p. 28.
1951. *Acanthoceras sussexiense* (Mantell); Wright & Wright, p. 28.
1963. *Acanthoceras mirialampiense* sp. nov.; Wright, p. 66, Pl. 84, Fig. 1, and Pl. 85, Fig. 1.
1970. *Acanthoceras rhotomagense* var. *sussexiense* (Mantell 1822); Kennedy & Hancock, pp. 472—474, Text-figs 3—5 and 6a, Pl. 89, Fig. 2, Pl. 91, Figs 1—2, and Pl. 92, Figs 1—2 [*cum syn.*].
1971. *Acanthoceras rhotomagense sussexiense* (Mantell); Kennedy, p. 86.
1972. *Acanthoceras (Acanthoceras) sussexiense* (Mantell); Thomel, pp. 144—145, Pl. 72, Figs 1—3, Pl. 73, Pl. 74, Figs 1—5, and Pl. 75, Figs 1—3.
1972. *Acanthoceras (Acanthoceras) sussexiense baylei* nov. subsp.; Thomel, pp. 145—146, Pl. 76, Figs 1—3.
1972. *Acanthoceras (Acanthoceras) sussexiense compressum* nov. subsp.; Thomel, p. 146, Pl. 79, Figs 1—2.
?1972. *Acanthoceras (Acanthoceras)* sp. gr. *sussexiense* (Mantell); Thomel, pp. 146—147, Pl. 78, Fig. 1.
1972. *Acanthoceras (Acanthoceras) sussexiense vectense* Spath; Thomel, p. 148, Pl. 77, Fig. 2.

1976. *Acanthoceras rhotomagense sussexiense* (Mantell, 1822); Juignet & Kennedy, pp. 116—117, Pl. 30, Figs 2 and 4.
1976. *Acanthoceras rhotomagense* (Brongniart) *sussexiense* (Mantell); Kennedy & Hancock, p. 38, Pl. 9, Fig. 7.

Material: Three diagenetically flattened, but rather well preserved specimens, Nos *Tr 54* (Pl. 19, Fig. 2), *Tr 56* (Pl. 20, Fig. 1), and *Tr 55* (Pl. 20, Fig. 2).

Table 33

Specimen No.	D mm	Wh %	U %	R	Rp	Rs
Tr 54	116.8	43	31	22	22	0
Tr 55	129.8	43	31	19	19	0
	89.0	41	30	21	18	3
Tr 56	132.3	42	38	ca 22	22	0
	83.6	39	30	$\left(\frac{1}{2}\right)$13	13	0

Remarks. — Thomel (1972) advanced *Acanthoceras (A.) rhotomagense sussexiense* (Mantell) to the specific level and recognized a number of subspecies within it. When the subspecies *sussexiense* Mantell is diagnosed as by Kennedy & Hancock (1970, p. 473), which diagnosis seems to be accepted also by Thomel (1972, p. 144), Thomel's subspecies fall within the range of variability of the subspecies *sussexiense* (cf. Juignet & Kennedy 1976).

The investigated specimens vary in morphology but nevertheless, share the following characteristics diagnostic of *Acanthoceras (A.) rhotomagense sussexiense*: (*i*) rounded, slightly rursiradiate ribs, all of which are long at a great shell diameter (intercalar ribs occur only at less than 90 mm in diameter); (*ii*) strong umbilical bullae and lower and upper ventro-lateral tubercles; and (*iii*) small siphonal tubercles decreasing in conspicuousness in ontogeny. The whorl cross section and the width of the venter cannot be recognized in the investigated specimens because of their diagenetic compression.

The specimen No. *Tr 54* (Pl. 19, Fig. 2) shows 3 ribs, out of the total 22 ribs preserved, with less prominent umbilical bullae. Its ornamentation and umbilical width make it very close to the form discussed by Thomel (1972, pp. 144—145, Pl. 75, Figs 1—3).

The specimen No. *Tr 55* (Pl. 20, Fig. 2) shows rather clavate ventro-lateral tubercles which feature makes a resemblance to *Acanthoceras (A.) rhotomagense clavatum* Kennedy & Hancock. However, the occurrence of prominent umbilical bullae, as well as the equality in size of the lower and upper ventro-lateral tubercles indicate that this is a form transitional between the subspecies *sussexiense* Mantell and *clavatum* Kennedy & Hancock. The number of ribs per whorl increases with a decrease in shell diameter, and there are 3 secondary ribs per whorl at a diameter of 89 mm.

Finally, the specimen No. *Tr 56* (Pl. 20, Fig. 1) shows rather sparse ribs at the outer whorl, passing also onto the venter. The umbilical bullae, as well as the lower and upper ventro-lateral tubercles are conspicuous. The siphonal tubercles are somewhat clavate and only a little smaller in size than the upper ventro-lateral ones. They are recognizable even at a diameter of c. 84 mm.

These characteristics indicate that the considered specimen is to be attributed to *Acanthoceras (A.) rhotomagense sussexiense*, even though it differs from the lectotype (*cf.* Kennedy & Hancock 1970, pp. 473—474, Pl. 91, Fig. 1) in its greater evoluteness at a large diameter, and a considerable decrease in rib number per whorl in ontogeny.

Occurrence. — No. *Tr 54*: Middle Cenomanian, Rats-Berges by Deersheim, Subhercynian Basin; Nos *Tr 55* and *56*: Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The subspecies *Acanthoceras (A.) rhotomagense sussexiense* (Mantell) has been recorded in the Middle Cenomanian of England, France, Madagascar, and northern Australia.

Acanthoceras (Acanthoceras) sp.
(Pl. 19, Fig. 3)

Material: A whorl-quarter presenting the phragmocone of a large-sized specimen, No. *Tr 51*.

Description. — The preserved whorl fragment bears 6 ribs, all of which seem to be long (this cannot be ascertained because of the poor preservation state) and passing onto the venter. There are poorly developed umbilical bullae and lower and upper ventro-lateral tubercles. The whorl is polygonal in costal cross section, and more rounded, subsquare in intercostal cross section (Wh=67.6 mm, Wb=65 mm), with the maximum whorl breadth at a one third of the whorl height.

Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

Subgenus *GUERANGERICERAS* Thomel, 1972
(Type species: *Ammonites confusus* Guéranger, 1867)

Acanthoceras (Guerangericeras) cf. *confusum* (Guéranger, 1867)
(Pl. 18, Fig. 4)

1975. *Acanthoceras* cf. *hippocastanum* (Sharpe); Naidin, Wantchurov & Alekseev, p. 83.

Material: Whorl fragment, No. *78.9013*.

Remarks. — The occurrence of strongly developed, pointed lower ventro-lateral tubercles, smaller-sized and clavate upper ventro-lateral tubercles, and small-sized and clavate siphonal ones makes the investigated specimen (Pl. 18, Fig. 4) almost indistinguishable from "*Ammonites hippocastanum*" of Sharpe (1856, Pl. 17, Fig. 4) which was attributed by Kennedy & Hancock (1970, p. 478) to the subspecies *Acanthoceras rhotomagense confusum* (Guéranger). The present auhtor is of the opinion that the form *confusum* Guéranger is so different from other representatives of the "*rhotomagense*" group that it is to be advanced not only to the specific, but even to the subgeneric level (*see* remarks on the subgenus *Guerangericeras* Thomel *in* Marcinowski 1979). The specimen under discussion was previously assigned by Naidin & *al.* (1975, p. 83) to *Acanthoceras* cf. *hippocastanum* (Sharpe, non J. de C. Sowerby) which corroborates its attribution to the subgenus *Guerangericeras*. It shows a very prominent and pointed lower ventro-lateral tubercle at each rib, while true *A. hippocastanum* (J. de C. Sowerby) shows at a comparable diameter shorter ribs devoid of lower ventro-lateral tubercles, very regularly alternating with the long ribs (*cf.* Kennedy 1971, p. 87, Pl. 51). It is also to be noted that the species *A. hippocastanum* has thus far been reported only from the Upper Cenomanian (*cf.* Kennedy & Hancock 1970, p. 479; Kennedy 1971, p. 88); whereas the investigated specimen was collected in the Middle Cenomanian of Crimea.

Occurrence. Middle Cenomanian, southern slope of the Mt. Selbukhra, Band *IV-2* (Bed 4), Crimea (*cf.* Text-fig. 6).

Subgenus *ALTERNACANTHOCERAS* Marcinowski, 1979
(Type species: *Protacanthoceras jukes-brownei* Spath, 1926)
Acanthoceras (Alternacanthoceras) jukesbrownei (Spath, 1926)

1857. ***Ammonites hippocastanum***, **Sowerby; Sharpe [*partim*], pp. 37—38, Pl. 17, Fig. 2.**
1926a. ***Protacanthoceras jukes-brownei*** **nom. nov.; Spath, p. 82.**
1979. ***Acanthoceras (Alternacanthoceras) jukesbrownei*** **(Spath, 1926); Marcinowski, pp. 62—64, Pl. 1, Fig. 1 [*cum syn.*] *.**

***Material*: Well preserved specimen, No. *Tr 64*.**

Occurrence. — Middle Cenomanian, beds with *Acanthoceras* in the Hoppenstedt quarry, northern limb of the Subhercynian Basin (*cf.* Text-fig. 2).

The species *Acanthoceras (Alternacanthoceras) jukesbrownei* (Spath) has been recorded in the upper Middle Cenomanian of southern England and France (Kennedy & Hancock 1970, Juignet & Kennedy 1976), and possibly in coeval strata of Kopet-Dag, the Soviet Union (*cf.* Atabekyan 1961, p. 63).

Family **Tissotiidae** Hyatt, 1900
Subfamily **Pseudotissotiinae** Hyatt, 1903
Genus *PSEUDOTISSOTIA* Peron, 1897
(Type species: *Ammonites galliennei* d'Orbigny, 1850)

Occurrence. — The genus *Pseudotissotia* Peron occurs in the Upper Cenomanian of England, and the Lower Turonian of France, Spain, northern and western Africa, Israel and Syria, the United States (Texas), Mexico, and South America.

The genus had been claimed to have appeared in the Lower Turonian (Reyment 1955, 1958, 1965; Wright 1957; Freund & Raabe 1969), but Kennedy & Bayliss (1977) have established a new species, *Pseudotissotia (P.) inopinata*, after specimens derived from unquestionable Upper Cenomanian strata. The specimen described below as *Pseudotissotia* sp. was collected from the Middle Cenomanian strata, which corroborates the supposition of Kennedy & Bayliss (1977, p. 905) that the genus *Pseudotissotia* Peron evolved from the Cenomanian acanthoceratids; in the present author's opinion it most probably derived from the Middle Cenomanian ones.

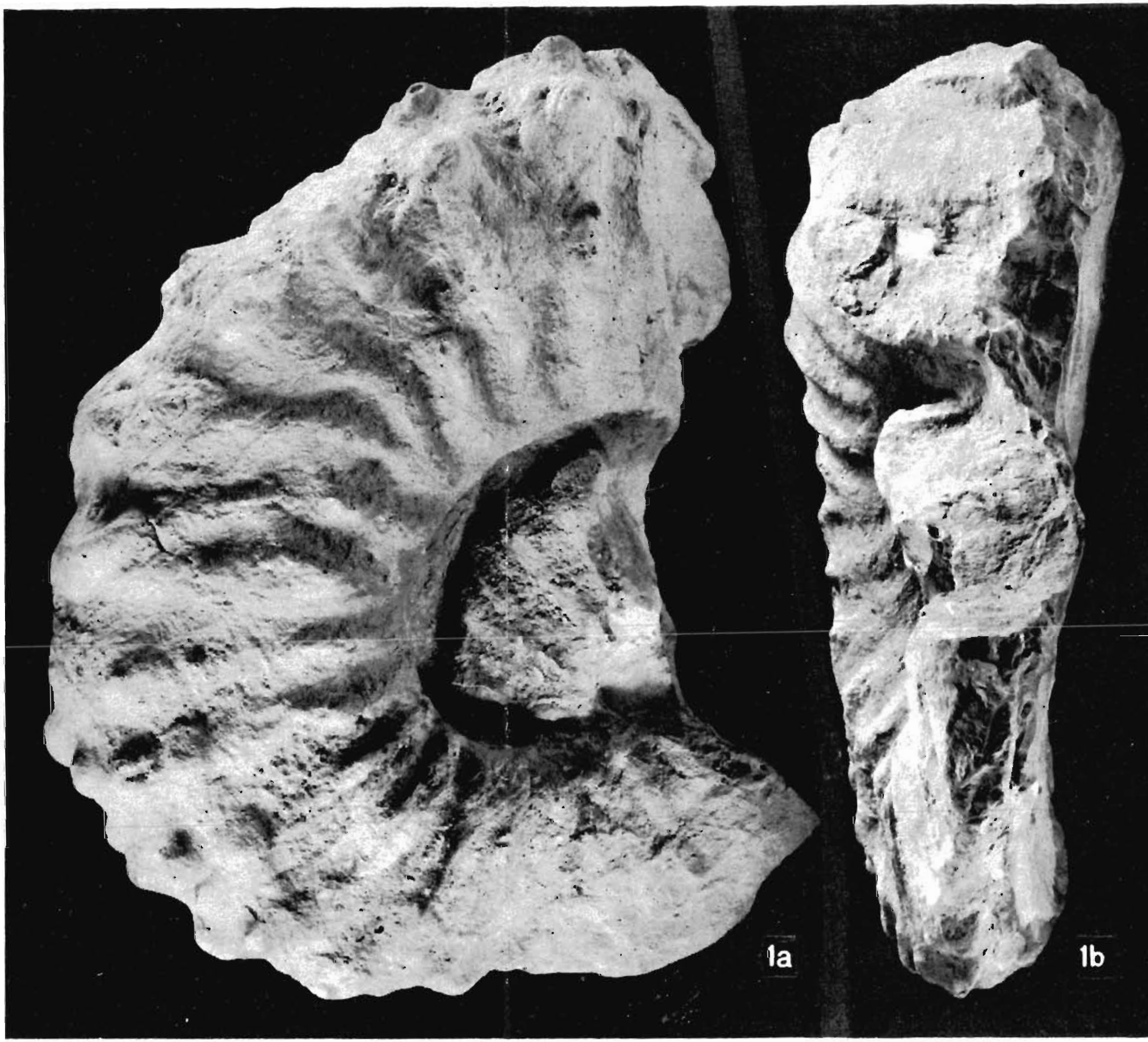
Pseudotissotia sp.
(Pl. 2, Fig. 15)

Material: Whorl fragment, No. *158.7750*.

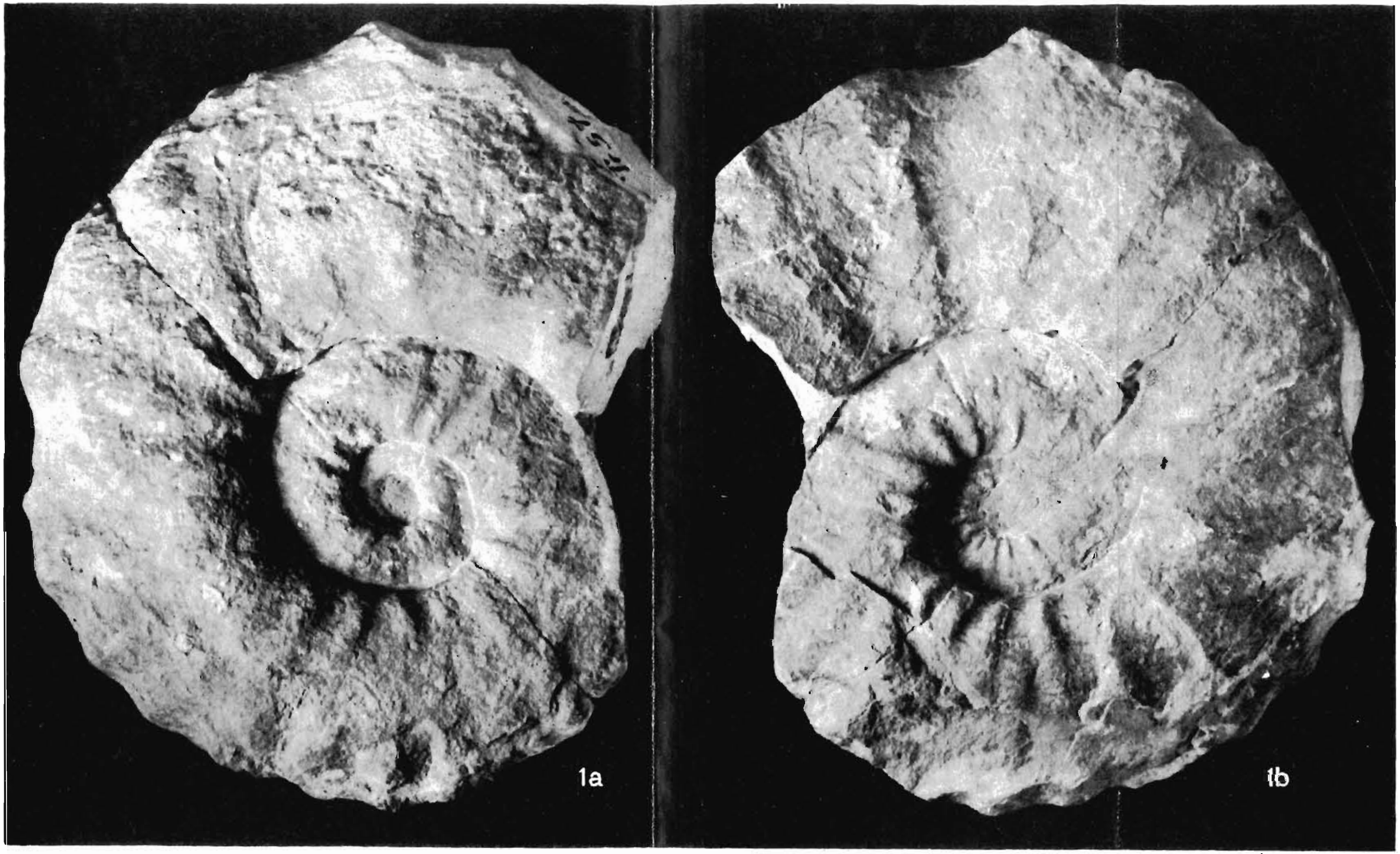
Remarks. — The investigated specimen (Pl. 2, Fig. 15) shows whorls smooth and flat-sided, with three faintly crenulate ventral keels. The median keel is more prominent and wide than the marginal ones. These characteristics make the

* The specimen of "*Ammonites hudai*" of Frič (1911) attributed previously by the present author (Marcinowski 1979, p. 62) to the subgenus *Alternacanthoceras* belongs actually to *Mammites nodosoides* (Schlotheim) and was collected from the Inoceramus labiatus Zone (Mr. P. Svoboda, *pers. communication*).

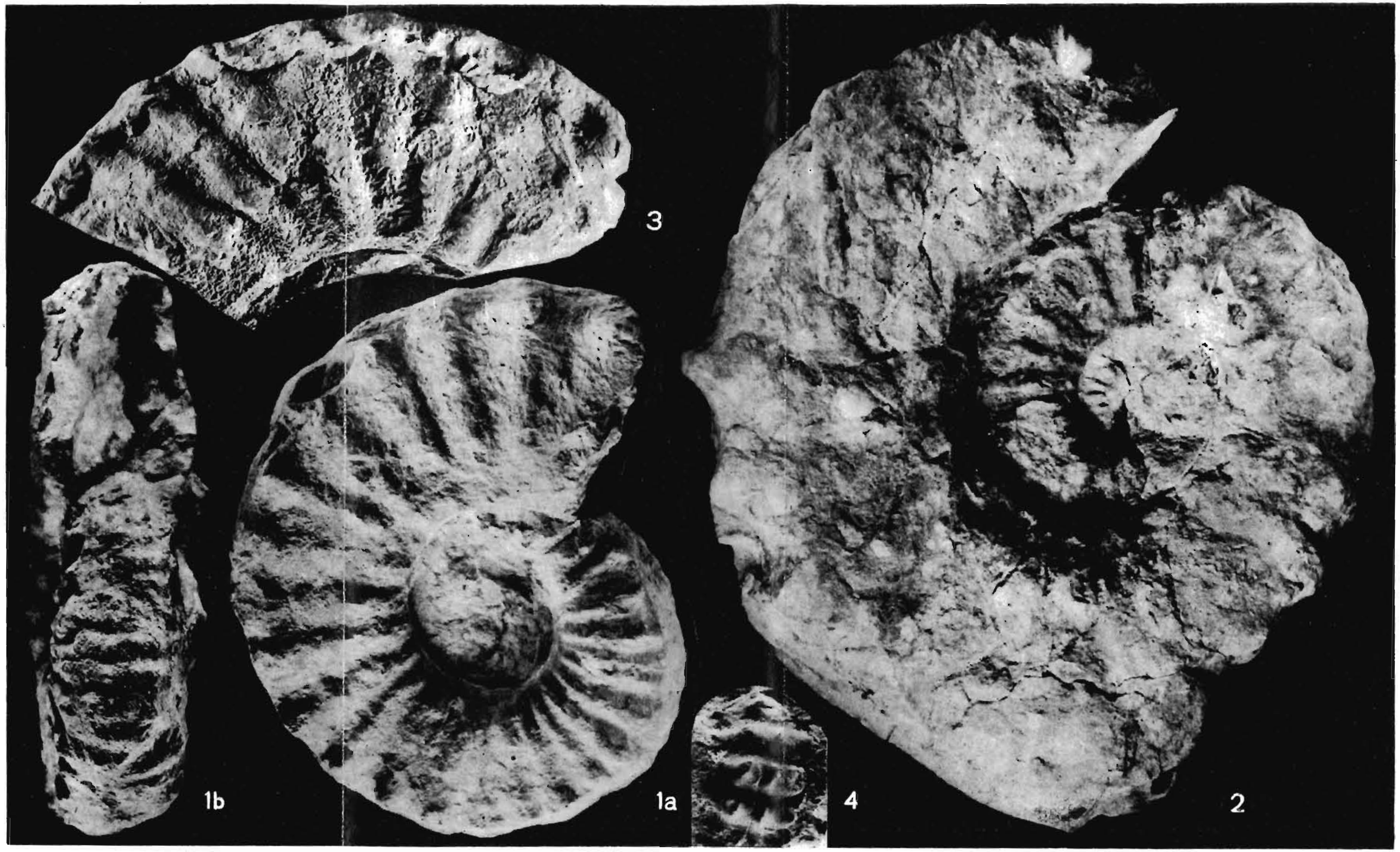
Calycoceras (Newboldiceras) newboldi newboldi (Kossmat): **1** — specimen No. Tr 61 (cast), low Upper Cenomanian, Niederschöna near Freiberg, Unterquader, × 0.75



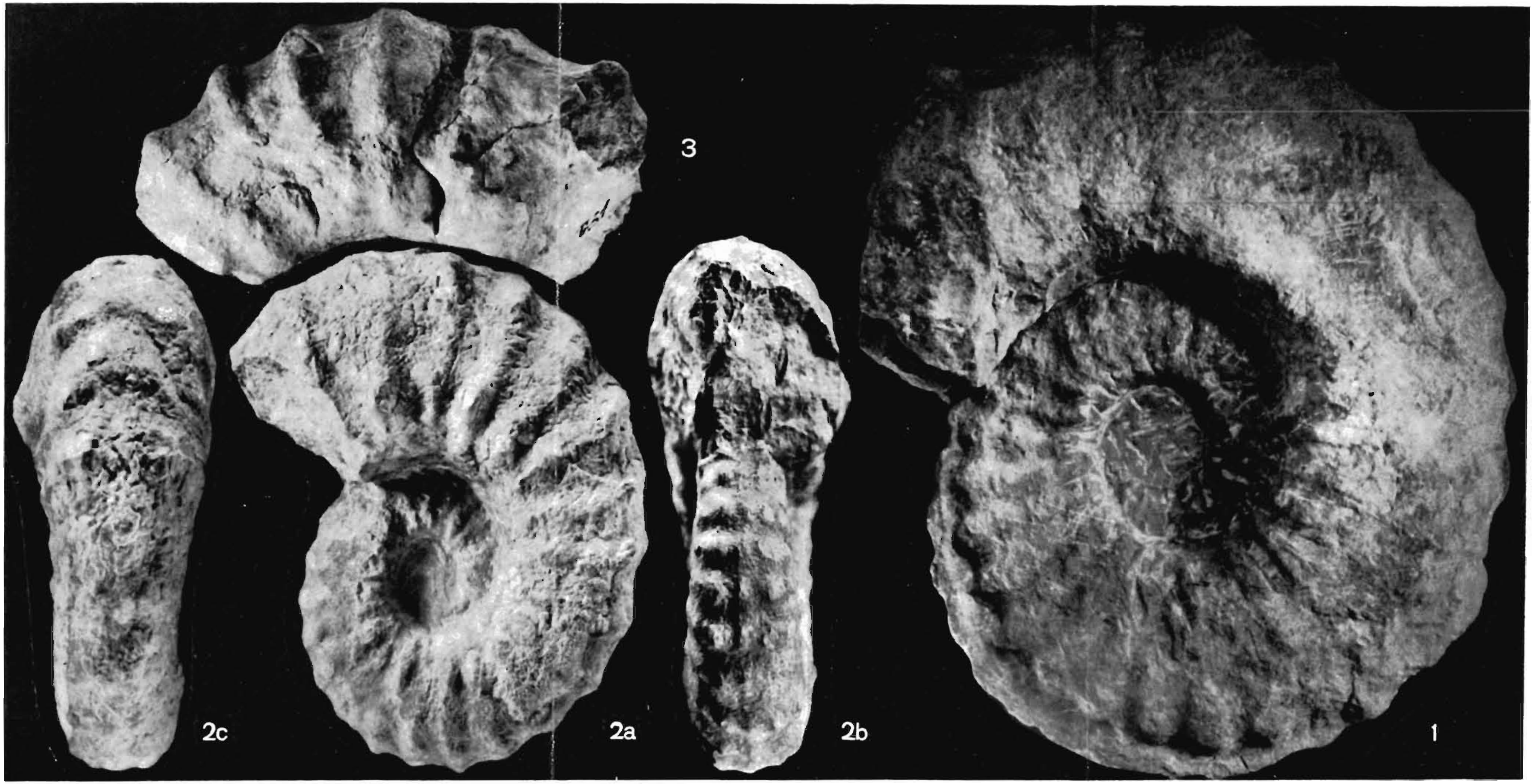
Calycoceras (Newboldiceras) spinosum nodosum (Thomel): 1 — specimen No. Tr 53 (cast), Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras*, × 0.8



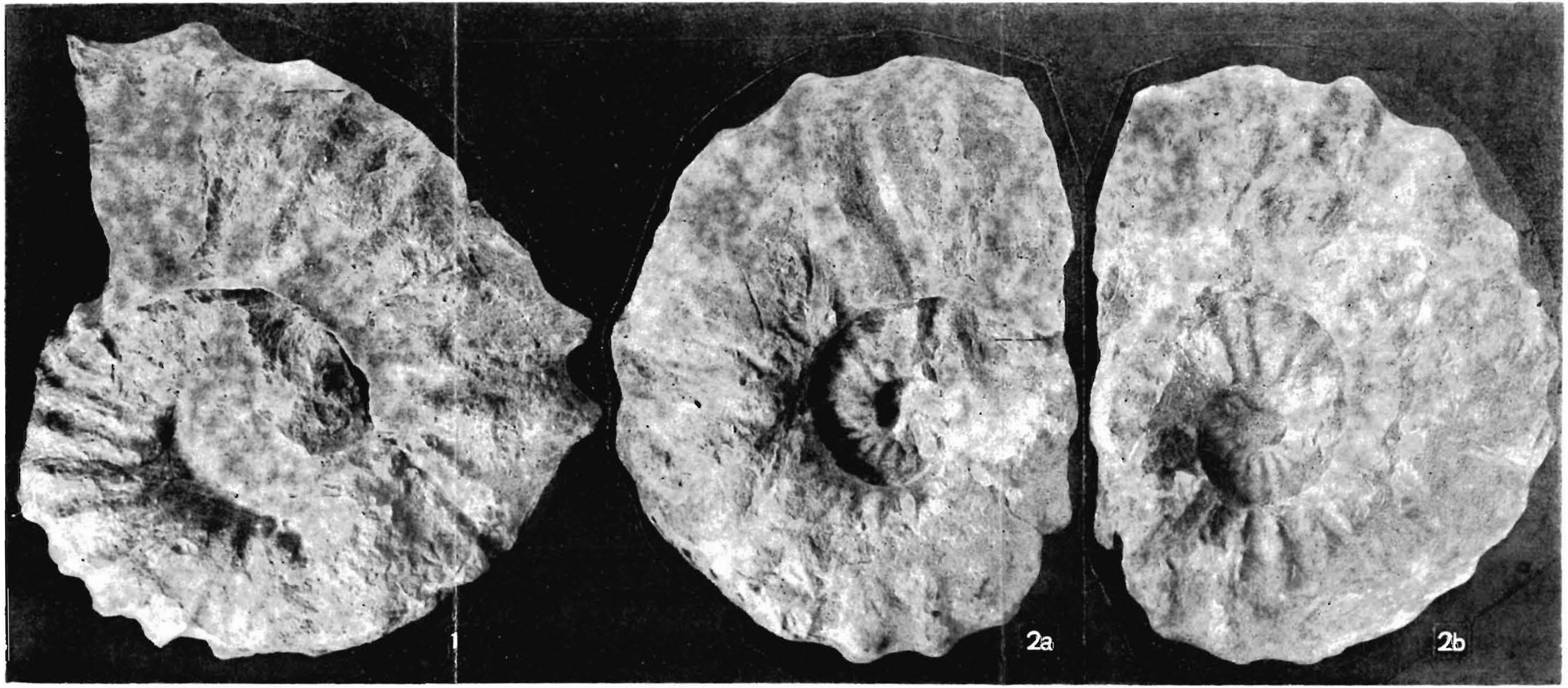
Acanthoceras (Acanthoceras) rhotomagense rhotomagense (Brongniart): **1** — specimen No. Tr 57, Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras*, × 1



Acanthoceras (Acanthoceras) rhotomagense rhotomagense (Brongniart): **1** — specimen No. Tr 59, × 1; **2** — No. Tr 52, × 0.6; Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras*. **Acanthoceras (Acanthoceras) rhotomagense** cf. **subflexuosum** Spath: **3** — specimen No. 136.82a, Middle Cenomanian, Ajmaki, × 1. **Acanthoceras (Guerangericeras)** cf. **confusum** (Guéranger): **4** — specimen No. 78.9013, Middle Cenomanian, Mt. Selbukhra, Band IV-2 Bed. 4, × 2



Acanthoceras (Acanthoceras) rhotomagense subflexuosum Spath: 1 — specimen No. Tr 58, Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras*, × 0.85. **Acanthoceras (Acanthoceras) rhotomagense sussexiense** (Mantell): 2 — specimen No. Tr 54, Middle Cenomanian, Rats-Berges near Deersheim, × 1. **Acanthoceras (Acanthoceras)** sp.: 3 — specimen No. Tr 51, Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras*, × 0.7



Acanthoceras (Acanthoceras) rhotomagense sussexiense (Mantell): 1 — specimen No. Tr 56, ×1; 2 — No. Tr 55, ×1; Middle Cenomanian, Hoppenstedt, beds with *Acanthoceras* specimen close to the subgenus *Bauchioceras* Reyment (*cf.* Reyment 1955, pp. 70—71; Wright 1957, p. L422) rather than to the nominative subgenus *Pseudotissotia* Peron, as the venter displays three strong and equal keels in the latter (Kennedy & Bayliss 1977, p. 902). However, the specimen is too fragmentary to be attributable to one or the other subgenus.

Occurrence. — Middle Cenomanian, MGU Station, uppermost part of Band *IV*-2 or lower part of Band *V*, Crimea (*cf.* Text-fig. 6).

REMARKS ON ECOLOGIC AND BATHYMETRIC REQUIREMENTS, AND ZOOGEOGRAPHIC SIGNIFICANCE OF THE INVESTIGATED AMMONITE ASSEMBLAGES

The ammonite fauna is broadly meant autochthonous in all the investigated sections. Aside of the sedimentologic data, this is evidenced by the good preservation state of heteromorph ammonites in the sections of Hoppenstedt, Southwestern Crimea Highland, Ajmaki, and Sullu-kapy. Any significant transportation of shells is denied by their preservation state even in those sections showing a considerable stratigraphic condensation (Annopol, Podzametschek). The autochthonous nature of the ammonite assemblages allows to recognize them for fairly close in composition to the original communities. The Lower to Middle Cenomanian ammonites will be discussed in this very context below, whereas the Upper Cenomanian ones will be disregarded because of either their extreme rarity (Annopol and Saxony) or their total absence in the investigated sections.

All the investigated Lower to Middle Cenomanian ammonite assemblages resemble one another in composition, being dominated by representatives of the genus *Schloenbachia* associated with heteromorphs (*cf.* Table 2). In the Southwestern Crimea Highland and Dagestan Caucasus these two groups are associated with numerous puzosiids; the occurrence of phylloceratids, gaudryceratids, and tetragonitids in those areas also is notable. In turn, the genus *Hyphoplites* equals in abundance *Schloenbachia* in the Lower Cenomanian of Mangyshlak. The small variability in composition of the ammonite assemblages over a wide range of lithofacies (sandy to marly-carbonate deposits; *cf.* Text-figs 2—4, 6, 9—10, and 12) indicates that the ammonites were only weakly dependent upon facies (*cf.* also Kennedy & Cobban 1976, p. 44 and Table 1).

As recognized in the Upper Turonian ammonite fauna of Hokkaido, Japan, the strongly ornate collignoniceratids (group *A*) and heteromorphs (group *B*) were nektobenthic or vagile benthic, while the smooth or weakly ornate tetragonitids, phylloceratids, and desmoceratids (group *C*) were planktic or nektoplanktic (Tanabe & *al.* 1978, p. 57). When the mode of ornamentation of the investigated Cenomanian ammonites is taken into account, one may assign, by analogy, the schloenbachiids to the group *A*, the heteromorphs (mainly baculitids, turrilitids, and scaphitids) to the group *B*, and the phylloceratids, gaudryceratids, tetragonitids, and puzosiids to the group *C*. The predominance of *Schloenbachia* and heteromorphs in the investigated ammonite assemblages is thus indicative of nearshore to offshore environments of moderate depth, which habitat is favorable for the ammonite groups *A* and *B* of Tanabe & *al.* (1978, Fig. 10), or the lowerneritic zone of the classic model of Scott (1940, p. 317, Fig. 8). The higher proportion of the puzosiids and the presence of the phylloceratids, gaudryceratids, and tetragonitids in the assemblages from the Southwestern Crimea Highland and Dagestan Caucasus are a suggestive of an environment somewhat deeper than requested by the groups *A* and *B* under discussion (*cf.* Wiedmann 1975, Fig. 1*b*; Tanabe & *al.* 1978, Fig. 10). The wide geographic distribution of benthic and/or epibenthic forms, in particular *Worthoceras, Hamites, Sciponoceras, Turrilites, Hypoturrilites,* and *Scaphites,* is notable because it is strongly suggestive of their independence of, or considerable resistance to general environmental changes at their juvenile stages when they settled, after a pelagic larval spread, in various geographic zones (Marcinowski 1974, p. 180; *cf.* also Kennedy & Cobban 1976, pp. 52—54). This undermines Scott's (1940, pp. 308—309) assertion that the ammonite larvae were intolerant of temperature changes which hampered their wide pelagic spread.

The ammonite assemblages rich in *Schloenbachia* and *Hyphoplites* show the Boreal affinities. In the Southwestern Crimea Highland and Dagestan Caucasus the genus *Schloenbachia* is accompanied by the puzosiids and relatively frequent phylloceratids, gaudryceratids, and tetragonitids (*cf.* Table 2), which is indicative of the Mediterranean affinities. By the way, it is to be kept in mind that even though the Southwestern Crimea Highland formally makes part of the marginal zone of the Tethys geosyncline, the platform, epicontinental sedimentation onset in that area already during the Late Albian resulted in a considerable resemblance of facies to the northwestern European Upper Cretaceous (*cf.* Marcinowski & Naidin 1976, Tröger 1978, Naidin 1979, Naidin & Alekseev 1980). The predominance of *Schloenbachia* and *Hyphoplites* (the latter in the Lower Cenomanian) in the ammonite assemblages from Mangyshlak points to their Boreal affinities, although this is counter-evidenced, to some extent, by the infrequent occurrence of placenticeratids of the genus *Karamaites*. The Boreal nature of ammonite faunas is clearly recognizable all over the investigated area, with the Kopet-Dag region included, which permits a correlation of those distant geological sections to the stratigraphic subdivision of the Cenomanian in northwestern Europe (*cf.* Table 1). Boreal affinities are also displayed by the Lower Cenomanian ammonite fauna from Esfahan in Iran (Kennedy & *al.* 1979). One may conclude that the southern boundary of the Boreal Realm was much to the south off the present-day position of the Southwestern Crimea Highland, Caucasus, and Kopet-Dag during the Early to Middle Cenomanian. Supposedly, it reached the Zagros tectonic line setting at present the northeastern limit to the Arabian platform (*cf.* Kennedy & *al.* 1979).

In all the investigated sections a considerable decrease in frequency, or even an absence, of ammonites and other macrofossils is observed in the Upper Cenomanian strata (*cf.* Text-figs 2—3, 6, and 12). This widespread phenomenon, reported also from North America as well as from deep-sea drillings in the North Atlantic and Pacific, commonly is related to a global deepening of Late Cenomanian basins which effected a change in phytoplanktic productivity and calcium carbonate deposition after the mid-Cenomanian non-sequence (Hart & Tarling 1974). This hypothesis stems from a considerable decrease in frequency of benthic foraminifers and increase in abundance of planktic ones commonly observed above the mid-Cenomanian non-sequence. However, there is no change in planktic to benthic foraminifers ratio in the Cenomanian of the Southwestern Crimea Highland, and the entire section is equally rich in planktic forms (Naidin & Alekseev 1980). On the other hand, in the Polish Jura Chain a shallowing of the sea evidently happened at the Late Cenomanian time (Marcinowski 1970, 1974). The Cenomanian /Lower Turonian deposits of the Podolia, stratigraphically condensed and with redeposited macrofossils, also can hardly be considered as deeper-water sediments. This is the case with the non-fossiliferous, sandy-glauconitic strata overlying the ammonite-bearing layers in the Sullu-kapy section, as well. These observations indicate that neither pan-regional deepening of the sea (*cf.* Hart & Tarling 1974), nor local shallowing of some parts of the basins can be recognized as resulting in the ecologic conditions unfavorable for proliferation of macroorganisms.

As indicated by the paleogeography, the Middle Cretaceous transgression onto the European platform reached its maximum during the Early Turonian (*cf.* Samsonowicz 1925; Cieśliński 1959, 1976; Naidin 1959, 1969; Pożaryski 1960; Marcinowski 1974; Hancock 1975; Rawson & *al.* 1978). One may therefore suppose that some compounds from the adjacent land areas were supplied to the sedimentary basin with an increased intensity prior to that maximum (approximately at the Late Cenomanian), at the stage of increasing transgressive activity. This could induce a temporary change in water chemistry in the epicontinental seas, detrimental to some organisms which, in turn, could disturb the trophic chains and consequently, effect a rapid decrease in macrofaunal density.

The presented consideration points to a remarkable homogeneity of the Boreal Realm extending in the Cenomanian over a large part of the present-day Europe and the adjacent Mid-Asia. The Boreal Realm included platform areas, as well as geosynclinal (Tethyan) ones. This is evidenced by faunal and facies affinities recorded not only in the classic Cenomanian outcrops in southern England and northern France (*cf.* Juignet & Kennedy 1976), but also in the areas discussed in the present paper, ranging from the Subhercynian Basin and Saxony in German Democratic Republic, Polish Jura Chain (*cf.* Marcinowski 1970, 1974) and Holy Cross Mts in Poland, through the Podolia, Southwestern Crimea Highland and North Caucasus, as far eastwards as to Mangyshlak and Kopet-Dag in the Mid-Asia regions of the Soviet Union.

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AMONITY CENOMANU Z WYBRANYCH PROFILI NA OBSZARZE NIEMIECKIEJ REPUBLIKI DEMOKRATYCZNEJ, POLSKI I ZWIĄZKU RADZIECKIEGO

(Streszczenie)

Przedmiotem pracy są cenomańskie amonity pochodzące z profili zlokalizowanych na obszarach Niecki Subhercyńskiej, Saksonii, Jury Polskiej i mezozoicznego obrzeżenia Gór Świętokrzyskich, Podola, Krymu, dagestańskiego Kaukazu oraz Mangyszłaku. Profile zawierające badane amonity rozciągają się na dystansie ponad 3200 km (*por.* fig. 1—7 oraz 9—12) i są zlokalizowane zarówno na obszarze platformowym jak i geosynkliny alpejskiej. Stanowi to sprzyjającą okoliczność dla rozważań określających stratygraficzną i biogeograficzną wartość amonitów w cenomanie.

Badane amonity (*por.* fig. 8, 13—15, tabele 2—33 oraz pl. 1—20) reprezentują 98 gatunków i form należących do 27 rodzajów, przy czym w ogromnej większości są to gatunki o szerokim rozprzestrzenieniu geograficznym. Fakt ten oraz szczegółowa analiza zasięgów stratygraficznych poszczególnych gatunków umożliwia korelację odległych od siebie profili, a także porównanie regionalnych podziałów cenomanu w NRD, Polsce i ZSRR z podziałem stratygraficznym stosowanym w północno-zachodniej Europie (*patrz* tabela 1). Dobry stan zachowania i duża liczba okazów pozwoliły na wyodrębnienie mikro- i makrokonch u cenomańskich przedstawicieli z rodzajów *Sciponoceras, Scaphites* i *Puzosia*. Zwrócono uwagę na szczególny przypadek dymorfizmu u pospolitego gatunku *Sciponoceras baculoide* (Mantell), gdzie mikro- i makrokonchy nie różnią się wielkością ani ornamentacją muszli, a tylko typem apertury. Analiza stanu zachowania szczątków organicznych wyklucza ich dłuższy transport i pozwala uznać skład zachowanych w badanych osadach zespołów amonitowych za zbliżony do pierwotnego. Mało zmienny skład zespołów amonitowych w reprezentujących różne facje profilach (od piaszczystej do marglisto-węglanowej — *por.* fig. 2—4, 6, 9—10 oraz 12) wskazuje na niewielką zależność tych głowonogów od facji.

W zespołach amonitowych dolnego i środkowego cenomanu dominuje rodzaj *Schloenbachia* i heteromorfy (głównie przedstawiciele rodzin Baculitidae, Turrilitidae i Scaphitidae). Dokonana przez Tanabe, Obata i Futakami (1978) analiza zespołów amonitowych w górnym turonie Hokkaido wykazała, iż mocno ornamentowane collignoceratidy (grupa *A*) i heteromorfy (grupa *B*) ze względu na sposób życia należy uznać za nektobentos lub mobilny bentos, natomiast morfotypy o muszli gładkiej lub słabo ornamentowanej — phylloceratidy, tetragonitidy i desmoceratidy (grupa *C*) za organizmy wiodące planktoniczny lub nektoplanktoniczny tryb życia. Biorąc pod uwagę sposób ornamentacji badanych amonitów cenomańskich wydaje się prawdopodobnym, iż przez analogię schloenbachidy reprezentują grupę *A*, heteromorfy grupę *B*, natomiast do grupy C należą phylloceratidy, gau-

dryceratidy, tetragonitidy i puzosidy. Zważywszy, że skoro we wszystkich badanych profilach w zespołach amonitowych dominuje rodzaj *Schloenbachia* i heteromorfy, zatem osady je zawierające tworzyły się najprawdopodobniej na umiarkowanych głębokościach, w warunkach odpowiadającym pograniczu strefy brzegowej i otwartego morza; odpowiada to warunkom życia amonitów z pogranicza grupy *A* oraz *B* w modelu Tanabe, Obata i Futakami (1978) lub też w przybliżeniu strefie infranerytycznej w klasycznym modelu Scotta (1940). W profilach Krymu i dagestańskiego Kaukazu większy udział puzosidów oraz obecność praktycznie nie znanych w pozostałych profilach phylloceratidów, gaudryceratidów i tetragonitidów najprawdopodobniej wskazuje, iż osady zawierające te amonity tworzyły się w warunkach morza nieco głębszego.

Na całym badanym obszarze zespoły amonitowe zawierające licznych przedstawicieli z rodzaju *Schloenbachia*, a w pewnych profilach (Mangyszłak) również *Hyphoplites*, wykazują charakter borealny. Obecność phylloceratidów, gaudryceratidów i tetragonitidów praktycznie ogranicza się tylko do obszarów obejmujących Krym i Kaukaz (*patrz* tabela 2). Przy jednoczesnym występowaniu w tych regionach gatunków znanych z północno-zachodniej Europy, w tym także typowo borealnych reprezentantów z rodzajów *Schloenbachia* i *Hyphoplites*, uznać należy, iż w rozważanych regionach przynależnych w zasadzie do prowincji borealnej zaznaczyły się także wpływy medyterańskiej prowincji faunistycznej. Borealny charakter fauny amonitowej daje się również prześledzić w Kopet-Dagu i rejonie Isfahanu (Iran). W cenomanie zatem południowa granica prowincji borealnej na obszarze południowo-wschodniej Europy i przylegającym obszarze środkowej Azji przebiegała daleko na południe od dzisiejszych pasm Krymu, Kaukazu i Kopet-Dagu. Najprawdopodobniej sięgała ona ku południowi aż po lineament Zagros w Iranie, która to struktura tektoniczna ogranicza obecnie od północnego wschodu platformę arabską.

We wszystkich badanych profilach w osadach górnego cenomanu obserwuje się znaczne ograniczenie frekwencji amonitów i innej nie-amonitowej makrofauny, a w skrajnych przypadkach nawet jej brak (*por.* fig. 2—3, 6 oraz 12). To bardzo powszechne zjawisko, notowane poza obszarem platformowym Europy również z północnej Ameryki oraz z podmorskich wierceń na północnym Atlantyku i Pacyfiku, wiązane jest z globalnym pogłębieniem górnocenomańskich zbiorników (*patrz* Hart & Tarling 1974). Analiza profili na badanym, rozległym obszarze wskazuje jednak, iż w górnym cenomanie zarówno pogłębienie jak i spłycenie pewnych partii zbiorników (np. na obszarze Jury Polskiej, *por.* Marcinowski 1974) nie stanowiło istotnych czynników, z którymi wiązać należy bezpośrednio powstanie warunków niekorzystnych dla życia makroorganizmów.

Jak wynika z ogólnego tła paleogeograficznego, na obszarze platformowym Europy transgresja środkowokredowa osiąga swoje maksimum w dolnym turonie. Wydaje się zatem prawdopodobnym, iż w etapie wzmożonej transgresji poprzedzającym to maksimum (w przybliżeniu w górnym cenomanie), do zbiorników sedymentacyjnych znoszone były w większej ilości różnej natury materiały terrygeniczne. Być może spowodowało to okresową zmianę chemizmu wód epikontynentalnych mórz, stwarzając niekorzystne warunki środowiskowe dla pewnych organizmów, a zaburzając łańcuch żywnościowy stało się odpowiedzialnym za zjawisko gwałtownego obniżenia frekwencji makrofauny, które obserwuje się w większości górnocenomańskich profili platformowej Europy.