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A new Middle Anisian (Middle Triassic) Ammonoid Zone from Northwestern Nevada (USA)

By HUGO BUCHER[1])

ABSTRACT

Recent investigations on Anisian ammonoid sequence from northwestern Nevada (Fossil Hill Member, Star Peak Group) lead to the recognition of a new zone, namely the *Taylori* Zone. This zone is bracketed between the previously known *Hyatti* and *Shoshonensis* Middle Anisian Zones. Four genera and ten species are also newly described.

RÉSUMÉ

Des recherches récentes dans l'Anisien du nord-ouest du Nevada (Fossil Hill Member, Star Peak Group) permettent d'introduire une nouvelle zone d'ammonites, la zone à *Taylori*. Celle-ci s'intercale entre les zones à *Hyatti* et *Shoshonensis* connues précédemment dans l'Anisien moyen. Quatre genres nouveaux et dix nouvelles espèces sont également décrits.

1. Introduction

This paper deals with ammonoids from the Fossil Hill Member, a member common to the Prida and Favret Formations of the Star Peak Group (Triassic carbonate basin in northwestern Nevada). The stratigraphy of that basin has been intensively worked out by SILBERLING & WALLACE (1969) and NICHOLS & SILBERLING (1977) to which the reader is referred for more details.

The whole Anisian ammonoid sequence ranging throughout the Fossil Hill Member was first partially described by pioneer works of HYATT & SMITH (1905) and SMITH (1914). This unusually complete faunal succession was recently monographed by SILBERLING & NICHOLS (1982). This last work brought to light what is considered as the world's most complete sequence of low paleolatitude Anisian ammonoid faunas. The present contribution adds to the Middle Anisian part of the basic biostratigraphic succession established by SILBERLING & NICHOLS (1982).

2. The Middle Anisian ammonoid sequence from Nevada

Early mapping (Mt. Tobin GQ, MULLER et al. 1951) by S.W. Muller revealed rich fossiliferous sites in the Favret Canyon (Augusta Mountains) and southern Tobin Range.

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He recognized the sequence of Middle Anisian ("*Acrochordiceras* Beds") followed by Upper Anisian ("*Daonella* Beds") in these two areas (Stanford University and USGS Mesozoic localities files).

Middle Anisian was then divided into two zones by SILBERLING & TOZER (1968) on account of new data from the North Humboldt Range for the *Varium* Zone and from the New Pass Range, Augusta Mountains and Tobin Range for the *Shoshonensis* Zone. The superposition of these two zones, as anticipated by SILBERLING & WALLACE (1969) and SILBERLING & TOZER (1968) was later demonstrated by SILBERLING (in BURKE 1973) in the southern Tobin Range. Further investigations led to a change in the *Varium* Zone appellation, as defined by TOZER (1967) in British Columbia where it makes up the whole Middle Anisian. It was thus replaced by the *Acrochordiceras hyatti* Beds in the Nevada sequence (TOZER 1974; NICHOLS & SILBERLING 1977). The Lower and Middle *Varium* Zone was thus correlated with the *A. hyatti* Beds and the Upper *Varium* Zone with the *Shoshonensis* Zone. Finally, the *Hyatti* Zone was formally introduced by SILBERLING & NICHOLS (1982) for the strata previously referred to the *A. hyatti* Beds.

Intensive sampling of the Middle Anisian strata has been recently carried out by the writer in the North Humboldt Range, southern Tobin Range, Augusta Mountains (Favret and Muller Canyons) and New Pass Range (McCoy and Wildhorse mines; Blackhorse and South Canyons). All over these ranges and where Middle Anisian strata are not locally affected by synsedimentary erosion or nondeposition, the constant occurrence of a clearly distinct ammonoid assemblage bracketed between the *Hyatti* Zone and the *Shoshonensis* Zone leads to the recognition of a new zone. Its index ammonoid is *Nevadisculites taylori* n. gen. n. sp. Following the convention used for Mesozoic ammonoid zones, this new zone is more briefly named the *Taylori* Zone.

The type area of this zone is located in the Favret Canyon where the *Hyatti*, *Taylori*, and *Shoshonensis* Zones are found in sequence below Upper Anisian faunas (Pl. 7). The main section is based on the best outcrops that are found on the steep slopes of the southern wall of the canyon where post-Triassic normal faults are easily mappable and do not obscure bed by bed sampling within each large fault-bounded block. Except for the lowermost few meters of the Fossil Hill Member that are attributed to the *Hyatti* Zone, the type area displays laterally continuous lithology within the rest of the member. The main section also provides valuable lithological markers (sandy resediments, cliff-forming dense groups of limestone beds, "paper shale"-like episodes, etc. ...) that allow correlations with sections less well exposed within the type area. Outside the type area where the Fossil Hill Member is more fully developed, lateral lithologic variations can seriously hamper resolution of sampling. As indicated by the Muller Canyon section, thickness of the *Taylori* Zone is drastically reduced over a distance of about 2 km south of the type area (Pl. 7).

3. Biochronologic procedure

The present way biochronologic units are set up is in accordance with the procedure advocated by TOZER (1967, 1971). As emphasized by the latter "it may be practical to leave open the alternative of placing the apparently unfossiliferous beds in either the upper or lower zone if they are eventually found to contain a characteristic fauna". This statement applies perfectly well to the *Taylori* Zone which is intercalated between the previously known *Hyatti* and *Shoshonensis* Zones (Fig. 1).

Substage	BRITISH COLUMBIA Tozer (1971 & 1974)		NORTHWESTERN NEVADA Silberling & Tozer (1968) Silberling & Nichols (1982)		NORTHWESTERN NEVADA (this report) Zones	Beds/Subzones	GEBZE (TURKEY) (Assereto 1972 & 1974) Zones	Faunas
Upper Anisian	DELEENI		ROTELLIFORMIS		ROTELLIFORMIS		TRINODOSUS	Fauna F
Middle Anisian	VARIUM	Upper	SHOSHONENSIS		SHOSHONENSIS	Upper	BINODOSUS	Fauna E
						Middle		Fauna D
						Lower		
			not recorded		TAYLORI	Praebalatonensis		Fauna C
						Escheri		
						Anagymnotoceras cf. A. spivaki		
		Middle	- - - - - - - - - - -			Nicholsi		
			HYATTI	Upper	HYATTI	Upper	ISMIDICUS	Fauna B
		Lower		Lower		Lower	OSMANI	Fauna A

Fig. 1. Chart showing the substage assignments of Middle Anisian and early Upper Anisian biochronologic units from the Fossil Hill Member (Star Peak Group, northwestern Nevada). Preliminary correlations are attempted with British Columbia and Turkey.

The kind of zones used in the discontinuous (discrete) sequences by TOZER (1967) and SILBERLING & TOZER (1968) are closely related to the concurrent-range-zones.

Special mention must also be made here in that refining a discontinuous biochronologic scale does not exclusively proceed by adding newly discovered faunas between those previously recognized. Given a constant amount of taxa, additional data about the ranges themselves are likely to produce either splitting or lumping of concurrent-range-type units.

From field evidence, it appears that the Middle Anisian faunal record of Nevada is highly discontinuous. Moreover, numerous sections yielded ammonoids of the *Taylori* Zone but none of them has a scope comparable with that of the Favret Canyon. This unfortunate difference is mainly due to poorly exposed bedrock together with variable sedimentation rates that affect strata referred to the zone quoted above.

The partial data from less important sections are however added to those of the type area. The resulting vertical ranges are then used to set up a synthetic and local sequence of concurrent-range-type units.

This deficiency of globally comparable sections prevents applying more elaborated methods such as the unitary associations (GUEX 1987) for which a test of lateral reproducibility is required. Nevertheless, the way data are presented here is suitable if using this method throughout a wider geographical realm. Reproducibility of biochronologic units could thus be tested on several synthetic local sequences scattered over a large geographic scale. In addition, this correlation procedure could resolve the fact that apparently contradictory data never fail to appear when trying to correlate biochronologic units over long distances.

For practical purposes, each unit is here arbitrarily named after a taxon occurring exclusively within the corresponding zone or beds.

With regard to the subzonal units established within the *Taylori* Zone and for the sake of consistency, the *Hyatti* Zone subzonal scheme (SILBERLING & NICHOLS 1982) is provisionally adopted here and the *Shoshonensis* Zone is unformally divided into three subzones (Fig. 1).

3.1 The Taylori Zone

Ammonoids distribution of the *Taylori* Zone is shown on Figure 2. At present state, four subzonal units or beds have been segregated.

Platycuccoceras n. sp. A and *Megaphyllites* n. sp. A range from the Upper *Hyatti* Zone up to the *Taylori* Zone. *Epacrochordiceras* cf. *E. enode* (HAUER), *Acrochordiceras carolinae* (MOJSISOVICS), *Intornites nevadanus* (HYATT & SMITH) and *Epigymnites* sp. A range from the *Taylori* Zone up to the *Shoshonensis* Zone. *Nevadisculites smithi* n. gen. n. sp., *Ussurites* cf. *U. arthaberi* (WELTER) and *Sageceras* cf. *S. walteri* MOJSISOVICS are long ranging forms which are common to the three Middle Anisian zones.

Z O N E	T A Y L O R I			
B E D S	Nicholsi	Anagymnotoceras cf. A. spivaki	Escheri	Praebalatonensis
Pseudodanubites nicholsi n.sp.	******************			
Platycuccoceras n. sp. A	**			
Anagymnotoceras sp. A		*****		
Anagymnotoceras cf. A. spivaki (Mc Learn)		****		
Anagymnotoceras sp. C			***	
Platycuccoceras favretense n.gen. n.sp.	****************	******************	******************	
Ptychites sp. A	****-------	-------**---------	*************	
Ptychites sp. B			*****	
Augustaceras escheri n.gen. n.sp.			*************	
Augustaceras staffordi n.gen. n.sp.			*************	
Epigymnites cf. E. jollyanus (Oppel)			*************	
Eogymnotoceras thompsoni n.gen. n.sp.			******************	
Nicomedites? tozeri n.sp.			******************	
Ismidites cf. I. marmarensis Arthaber	******************	******************	******************	
Nevadisculites taylori n.gen. n.sp		******************	******************	******************
Nevadisculites smithi n.gen. n.sp.	******************	******************	******************	-----------------
Megaphyllites n. sp. A	******************	******************	******************	
Epacrochordiceras cf. E. enode (Hauer)	******************	******************	******************	******************
Acrochordiceras carolinae (Mojsisovics)	******************	******************	******************	******************
Intornites nevadanus (Hyatt & Smith)	******************	******************	******************	******************
Ussurites cf. U. arthaberi (Welter)	******************	******************	******************	******************
Sageceras cf. S. walteri Mojsisovics	-----------------	-----------------	------------*****	-----------------
Platycuccoceras praebalatonensis n.gen. n.sp.				******************
Eogymnotoceras transiens n.gen. n.sp.				******************
Epigymnites sp. A				******************

Fig. 2. Stratigraphic distribution of the Taylori Zone ammonoids from the Fossil Hill Member.

Correlation of the Nevada Middle Anisian sequence with other coeval sections is beyond the scope of this paper. Such a study requires a revision of the whole of this substage throughout the Fossil Hill Member and this work is in preparation.

One can however anticipate (Fig. 1) that the *Taylori* Zone is potentially identifiable in British Columbia (MCLEARN 1969; TOZER 1967, 1971), at Gebze (Turkey, see TOULA 1896; ARTHABER 1914; ASSERETO 1972, 1974) and at Spiti (India, see DIENER, 1895, 1907). Correlative of the *Taylori* Zone at Spiti is also strengthened by recent sampling carried out by Krystyn (unpublished data). On the other hand, *Taylori* Zone correlative seems to be absent from Mediterranean and Eastern Europe (ASSERETO 1971; VÖRÖS 1987).

3.2. Conventions

The classification used in the descriptive part follows that of TOZER (1981).

Whorl height (H) and width (W) and umbilical width (U) are expressed in percentage of the diameter (D) at which measurements were taken. Width is measured between tubercules when present.

The author's data on the occurrence of taxa described hereafter include the number of specimens obtained from each locality. For example, HB 175 (2) means that 2 recognizable specimens were collected from locality HB 175. USGS Mesozoic localities (stored at the U.S. Geological Survey, Denver federal center) are listed the same way. Repository of figured specimens is abbreviated USNM (National Museum of Natural History, Washington, D.C.).

4. Systematic descriptions

Order *Ceratitida* Hyatt 1884

Superfamily *Ceratitaceae* Mojsisovics 1879

Family ***Balatonitidae*** Spath 1951

Genus *Augustaceras* n. gen.

Type species. – *Augustaceras escheri* n. sp.

Description. – Evolute, relatively thick whorled, coarsely ribbed and frequently spinose cuccoceratid. Whorl section subquadrate to suboval. *Augustaceras* is generally trituberculate, with marginal and umbilical tuberculation varying in strength and nodose to spinose lateral tuberculation.

Composition of the genus. – *Augustaceras escheri* n. sp., *A. staffordi* n. sp.

Discussion. – *Augustaceras* is significantly more evolute than *Cuccoceras cuccense* (Mojsisovics 1873) which is the type species of *Cuccoceras* Diener 1907. The latter also differs by its extremely weak ribbing and absence of lateral and marginal tuberculation. Compared with *Platycuccoceras* n. gen., *Guleites* Guo 1983 and *Balatonites* Mojsisovics 1879, *Augustaceras* has lower and thicker whorls and is generally more stoutly ornamented.

The name of this new genus is derived from the Augusta Mountains.

Occurrence. – Escheri Beds, *Taylori* Zone, Middle Anisian, Nevada.

Augustaceras escheri n. sp.

Plate 1, Figures 1–3, 7–8, 14–15; Text-Figure 3

Description. – Evolute, relatively thick whorled and stoutly spinose *Augustaceras*. At $D < 20$ mm, it has a subquadrate whorl section, small umbilical bullae, globose lateral tubercles and slightly projected massive marginal tubercles. Intercalated ribs do not bear lateral nodes or tubercles. Constrictions may even be interrupted when lateral tubercles are large enough. Venter subtabulate, crossed by low ribs. At $20 < D < 35$–40 mm, the whorl section gradually changes into a subrectangular shape and interrupted constrictions get so much closer that intercalated ribs do not develop. The rib bordering the adapical side of constrictions gets drastically larger and bears a high umbilical bullae and a lateral backwards bended spine that tends to coalesce an occasionally clavate marginal tubercle. Venter has a subfastigate outline and is crossed by chevron-shaped ribs. At $D > 40$ mm (body chamber), spacing between constrictions increases and spine strength decreases. Constrictions are continuously open and the adoral rib bears a lateral node.

Whorl section may retain a subrectangular shape with persistent, well pronounced umbilical bullae and chevron-shaped ribs crossing a fastigate venter. At the same stage of growth some other variants may have a suboval whorl section with faint umbilical and marginal tuberculation. On such variants, gently projected ribs cross an arched venter. Complete body chamber not known. At D = 47 mm, the holotype has H = 33%, W = 28% and U = 41%.

Suture line ceratitic, with a broad, somewhat asymetrical first lateral saddle. First lateral lobe weakly crenulated.

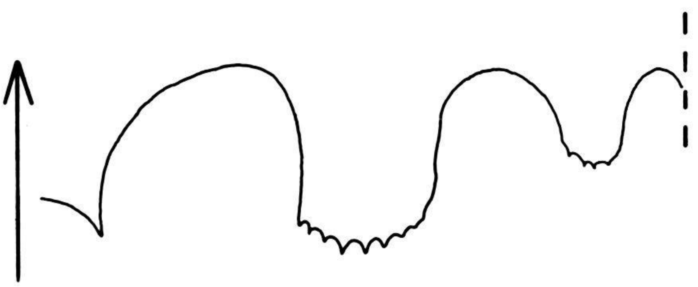

Fig. 3. Suture line (× 6) of *Augustaceras escheri* n. gen. n. sp. at D = 21 mm. Plesiotype USNM 427979 (specimen not figured). Loc. HB 175, Escheri Beds, *Taylori* Zone; Favret Canyon, Augusta Mnts.

Discussion. – *A. escheri* differs from *A. staffordi* n. sp. by its more robust tuberculation and its lower and thicker outer whorls.

Species named for A. Escher of the Institute of Geology and Paleontology, Lausanne University.

Figured specimens. – Holotype USNM 427235, plesiotypes USNM 427236, USNM 427237.

Occurrence. – HB 175 (2), HB 185 (2), HB 105 (2), HB 189 (1), Favret Canyon, Augusta Mountains; HB 156 (2), McCoy Mine, New Pass Range; Nevada. Escheri Beds, *Taylori* Zone, Middle Anisian.

Augustaceras staffordi n. sp.

Plate 1, Figures 9–13

Description. – Evolute, relatively thick whorled and finely spinose *Augustaceras*. At D < 20 mm, whorl section subrectangular to suboval, with umbilical bullae, elongated to massive marginal tubercles and lateral nodes on adapical ribs bordering constrictions. Constrictions encircle flanks and venter without interruption. Intercalated ribs may even bear small lateral nodes. The venter at first subtabulate, rapidly changes into an arched shape. At 20 < D < 35–40 mm, whorl section and venter retain the same outline. Adapical ribs develop radially elongated lateral spines just at or just below midflanks that do not fully interrupt constrictions. Lateral spines tend to coalesce the high umbilical bullae. Intercalated ribs also bear lateral nodes just below midflanks. Marginal and ventral ornamentation quite variable. Radially elongated or well defined marginal tubercles correspond respectively to faint or coarse slightly projected ribbing on venter. At D > 40 mm, the strength of lateral spines decreases and constrictions are again continuously open. Lateral nodes of intercalated ribs may or may not persist. Marginal and ventral ornamentation vary as in the preceeding stage of growth. The holotype is chosen from the less coarsely ornamented variants; at D = 47 mm, H = 34%, W = 27% and U = 41%. Suture line not known.

Discussion. – Specimens assigned to *A. staffordi* could represent more compressed and weaker ornamented variants of *A. escheri*. However, the amount of available specimens is not suitable to demonstrate such a continuous variation.

Species named for M.C. Stafford, Winnemucca, Nevada.

Figured specimens. – Holotype USNM 427239, plesiotype USNM 427238.

Occurrence. – HB 185 (2), HB 175 (4), HB 176 (2), HB 165 (4), Favret Canyon, Augusta Mountains; HB 156 (4), McCoy Mine, New Pass Range; Nevada. Escheri Beds, *Taylori* Zone, Middle Anisian.

Genus *Platycuccoceras* n. gen.

Type species. – *Platycuccoceras favretense* n. sp.

Description. – Evolute, high whorled and strongly laterally compressed cuccoceratid. Phragmocone with typically parallel flanks and arched to subtabulate venter. Whorl overlapping is characteristically reduced to the ventral area, the umbilical seam being located on the ventral shoulder of the preceeding whorl. Ornamentation variable, consisting of a well defined umbilical row of bullae and occasional lateral and marginal rows of nodes or tubercles. Lateral nodes occasionally enlarge into spines at some restricted stage of growth. Ribbing may also fade on midflanks. Body chamber ornamentation quite variable. Strength of tuberculation may either decrease or increase and may occasionally retain the phragmocone pattern without perceptible modifications. However, the number of adorally projected constrictions increases from end of phragmocone or beginning of body chamber onwards. The constrictions encircle the whole whorl excepted the dorsal part.

Composition of the genus. – *Platycuccoceras bonaevistae* (Hyatt & Smith 1905), *P.* n. sp. A, *P. favretense* n. sp., *P. praebalatonensis* n. sp., *P. yoga* (Diener 1907), *P. yoga* (sensu Wang & He 1981), *P. labiatus* (Hauer 1892), *P. bijiense* (Guo 1983), *P. carnicum* (Arthaber 1912).

Discussion. – Compared with *Cuccoceras cuccense* (Mojsisovics 1873), the type species of that genus, *Platycuccoceras* is significantly more evolute, more laterally compressed and provided with up to three rows of tubercles. Among the different species of *Cuccoceras* described by Arthaber (1912) from the Monte Cucco, only "*C*". *carnicum* Arthaber can be referred to *Platycuccoceras*. As first established by Arthaber (1912), *P. carnicum* was found to be associated with *Balatonites*. Recent investigations in this area led Assereto (in Metzeltin 1973) to confirm this association, the age of which is considered to be Pelsonian (European correlative of the *Shoshonensis* Zone).

Platycuccoceras differs from *Guleites* Guo 1983 by its arched to subtabulate rather than fastigate venter (Guo 1983, p. 110). Compared to *Augustaceras* n. gen., *Platycuccoceras* has higher and thinner whorl section. *Platycuccoceras* is distinguished from *Balato-*

nites MOJSISOVICS 1879 by absence of a fastigate venter, absence of a ventral tuberculation, and its non-persistent spinose ornamentation.

The name of this new genus refers to its platycone shape.

Occurrence. – Lower *Hyatti* Zone to Middle *Shoshonensis* Zone, Middle Anisian, Nevada. Muth, Spiti, "Upper Muschelkalk", India (DIENER 1907, 1912). "Muschelkalk", Han Bulog, Yugoslavia (HAUER 1892). Lower Pingergnam Group, Middle Triassic, Yunnan, China (GUO 1983). (?)*Paraceratites trinodosus* Zone, (?)Upper Anisian, Shuanghu district, Xizang, China (WANG & HE 1981; see next remarks below). Monte Cucco, Serla Formation, Pelsonian, Italy (ARTHABER 1912; METZELTIN 1973).

Remarks. – Because *Platycuccoceras* n. sp. A is much better represented in the Upper *Hyatti* Zone than in the Nicholsi Beds of the *Taylori* Zone, this species will be described in another paper dealing with the *Hyatti* Zone. Rare specimens of *Platycuccoceras* have been found in the *Shoshonensis* Zone but are not attributable to any of the previously known species, nor to these described hereafter.

As described by DIENER (1907), *Cuccoceras yoga* is closely allied to *Platycuccoceras* and is here included into this new genus. Examination of a specimen recently collected by L. Krystyn a Spiti confirms this generic attribution.

P. "yoga" illustrated by WANG & HE (1981, p. 294, Pl. 3, Fig. 1–3) from Xizang has a much finer ornamentation on the body chamber, with up to four ribs between to consecutive widely spaced constrictions. It should thus be distinguished at specific level from *P. yoga* (DIENER) whose body chamber has a coarse ribbing with only up to one rib between two consecutive constrictions. Owing to the faunal list given by WANG & HE (1981), the *Paraceratites trinodosus* age assignement for the Xizang form appears to be somewhat doubtful. Whithout excluding the possibility of a mixed or condensed fauna, presence of *Acrochordiceras (= Haydenites), Balatonites, Cuccoceras* and *Platycuccoceras* would amply justify an at least partly late Middle Anisian age.

"Cuccoceras cuccense" (MOJSISOVICS), as described by ZHAO & WANG (1974, Pl. 182, Fig. 3), probably corresponds to *Platycuccoceras*.

Platycuccoceras favretense n. sp.

Plate 1, Figures 16–20; Text-Figure 4

Description. – The main additional characters to the generic definition are a small mature size and absence of lateral nodes. Concave constrictions are prosiradiate on both phragmocone and body chamber. Ribbing is weak and fades on midflanks. Adorally projected small marginal tubercles outnumber umbilical nodes approximatively by 2 to 1 between two consecutive constrictions. Apart from constrictions, the venter is permanently arched and smooth, with moderate peripheral projection of growth lines. The mature body chamber, only partially known, seems to retain the phragmocone ornamentation except constrictions that become closely spaced. The holotype has a diameter of 42 mm, at which H = 32%, W = 16%, U = 40%.

Suture line subceratitic, with lateral lobe weakly or not at all crenulated at end of phragmocone. The umbilical part of the suture line is adorally deflected.

Discussion. – *Platycuccoceras favretense* has a smaller adult size than *P.* n. sp. A. Additional differences are: an even more laterally compressed whorl shape, a more

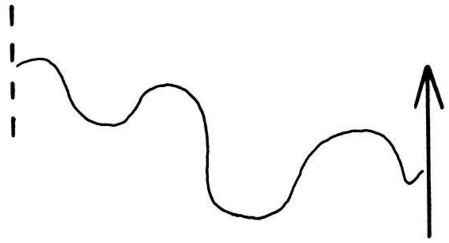

Fig. 4. Second before last suture line (× 6) of *Platycuccoceras favretense* n. gen. n. sp. at D = 21 mm. Syntype USNM 427240.

arched instead of subtabulate venter, a less dense and weaker ribbing combined with absence of lateral nodes on end of phragmocone and body chamber. Last suture lines are also simpler than these of *P.* n. sp. A that are truly ceratitic and not adorally deflected.

Platycuccoceras favretense differs from *P. praebalatonensis* n. sp. and *P. bonaevistae* (HYATT & SMITH) by its smaller mature size, its much weaker ribbing and absence of lateral tuberculation. *Platycuccoceras favretense* is comparatively closer to *P. labiatus* (HAUER) and *P. bijiense* (GUO) but differs from the former by having umbilical bullae and less indentated lateral saddles and from the later by its finer ribbing.

Species name derived from the Favret Canyon, Augusta Mountains.

Figured specimens. – Holotype USNM 427241, syntype USNM 427240.

Occurrence. – HB 1 (2), HB 36 (2), HB 28 (4), HB 27 (1), HB 30 (5), HB 68 (1), HB 42 (3), HB 29 (1), North Humboldt Range; HB 14 (12), HB 105 (4), HB 179 (11), HB 163 (2), HB 216 (1), HB 99 (1), HB 101 (2), HB 200 (1), HB 175 (1), HB 199 (2), HB 100 (1), HB 173 (2), Favret Canyon, Augusta Mountains; HB 179 (1), Muller Canyon, Augusta Mountains; HB 134 (1), Black Horse Canyon, New Pass Range; Nevada. Nicholsi to Escheri Beds, *Taylori* Zone, Middle Anisian.

Platycuccoceras praebalatonensis n. sp.

Plate 1, Figures 4–6; Plate 2, Figures 1–4; Text-Figure 5.

Description. – Large sized *Platycuccoceras* with a spinose stage restricted to the end of the phragmocone. At D < 20–25 mm, *P. praebalatonensis* bears small umbilical nodes and projected marginal tubercules. Ribbing is weak or absent on midflanks. Continuous constrictions are curved and prosiradiate. The fastigate venter is crossed by chevron-shaped ribs. At 20–25 < D < 40–50 mm, *P. praebalatonensis* is characterized by the sudden appearence of lateral nodes on adapical ribs bordering the constrictions. These enlarge extremely rapidly into spines that coalesce the adoral rib, thus interrupting the constrictions at midflanks. Umbilical bullae and marginal tubercles become prominent and intercalated ribs may be continuous. All the ribs cross the low arched venter with equal strenght. These are usually projected but may develop a chevron-shape among the coarsest variants. At D > 40–50 mm (body chamber), ornamentation fades drastically on lower flanks. Umbilical bullae almost disappear and lateral spines are reduced to very small, radially elongated nodes on adapical ribs. Those lateral nodes are more easily perceptible on internal molds than on outer shells. Very closely spaced constrictions become extremely shallow on inner flanks but remain deep on outer flanks and venters. Venters broader and subtabulate, crossed by thin, gently projected ribs.

The largest known specimen has a diameter of about 70 mm. At D = 61 mm, the holotype has H = 27%, W = 20% and U = 46%.

Suture line ceratitic, with somewhat asymetrical saddles. The umbilical part of the suture is adorally deflected.

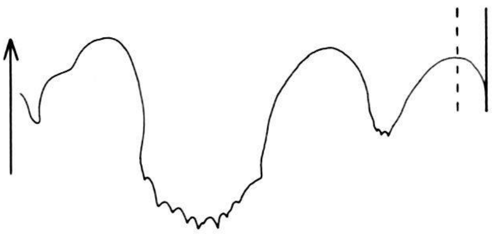

Fig. 5. Last suture line (× 3) of *Platycuccoceras praebalatonensis* n. gen. n. sp. at D = 41 mm. Holotype USNM 427243.

Discussion. – Apart from their fastigate venter crossed by chevron-shaped ribs, innermost whorls of *Platycuccoceras praebalatonensis* are almost similar to the coarsest variants of *P. favretense*.

Although inner whorls of *P. yoga* (DIENER 1907) and *P. "yoga"* in WANG & HE (1981) are not adequately known, both seem to have close affinities with *P. praebalatonensis*. Common characters of body chambers are the whorl section and the strongly reduced lateral nodes. However, *P. praebalatonensis* is distinguished from *P. yoga* (DIENER 1907) and *P. "yoga"* (sensu WANG & HE 1981) by its prosiradiate, much finer ribbing and its extremely closely spaced constrictions that persist only on outer flanks and venters.

Owing to the fastigate venter of inner whorls, species name suggests a possible phylogenetic origin for *Balatonites* MOJSISOVICS.

Figured specimens. – Holotype USNM 427243, syntypes USNM 427242, USNM 427244.

Occurrence. – HB 170 (7), HB 98 (1), USGS loc. M 718 A (1), Favret Canyon, Augusta Mountain, Nevada. Praebalatonensis Beds, *Taylori* Zone, Middle Anisian.

Family ***Ceratitidae*** MOJSISOVICS 1879

Subfamily ***Beyrichitinae*** SPATH 1934

Genus *Nicomedites* TOULA 1896

Nicomedites? *tozeri* n. sp.

Plate 2, Figures 5–9; Text-Figure 8

Description. – Compressed discoidal, high whorled and narrowly umbilicated beyrichitid. On phragmocone, inner flanks are subparallel whereas middle and outer flanks slowly converge towards the narrowly arched and permanently smooth venter. Growth lines permanently projected on venter during all ontogenetic development. Umbilical shoulder sharp, passing to a perpendicular umbilical wall. Sculpture weak, devoid of any lateral tuberculation. On inner whorls, up to three sinuous to falcoid ribs may stem from faint, elongated umbilical bullae. At the same stage, marginal tuberculation is faint and projected. On outer whorl, the branching point simultaneously loses all of its strenght and shifts from umbilical edge to outer third of flanks. Below branching point, ornamentation consists merely of prosiradiate, slightly concave and occasionally bundled striae instead of ribs. On the outer flanks, mainly single, faint and concave ribs are closely and regularly spaced. The resulting pattern on outer whorls is a subfalcate ribbing. The body chamber of mature specimens retains the same basic pattern but with decreasing strength. Outer flanks become subparallel and the venter gradually changes into a broad, comparatively low, arched outline. Mature stage is also enhanced by egression of the umbilical suture. Length of body chamber is at least of two thirds of a whorl.

Growth curves and variations of H%, W% and U% are respectively plotted on Figures 6 and 7.

Suture line subammonitic, with tip of umbilical saddles sightly projected on outer whorls. Lateral lobe finely and regularly indented.

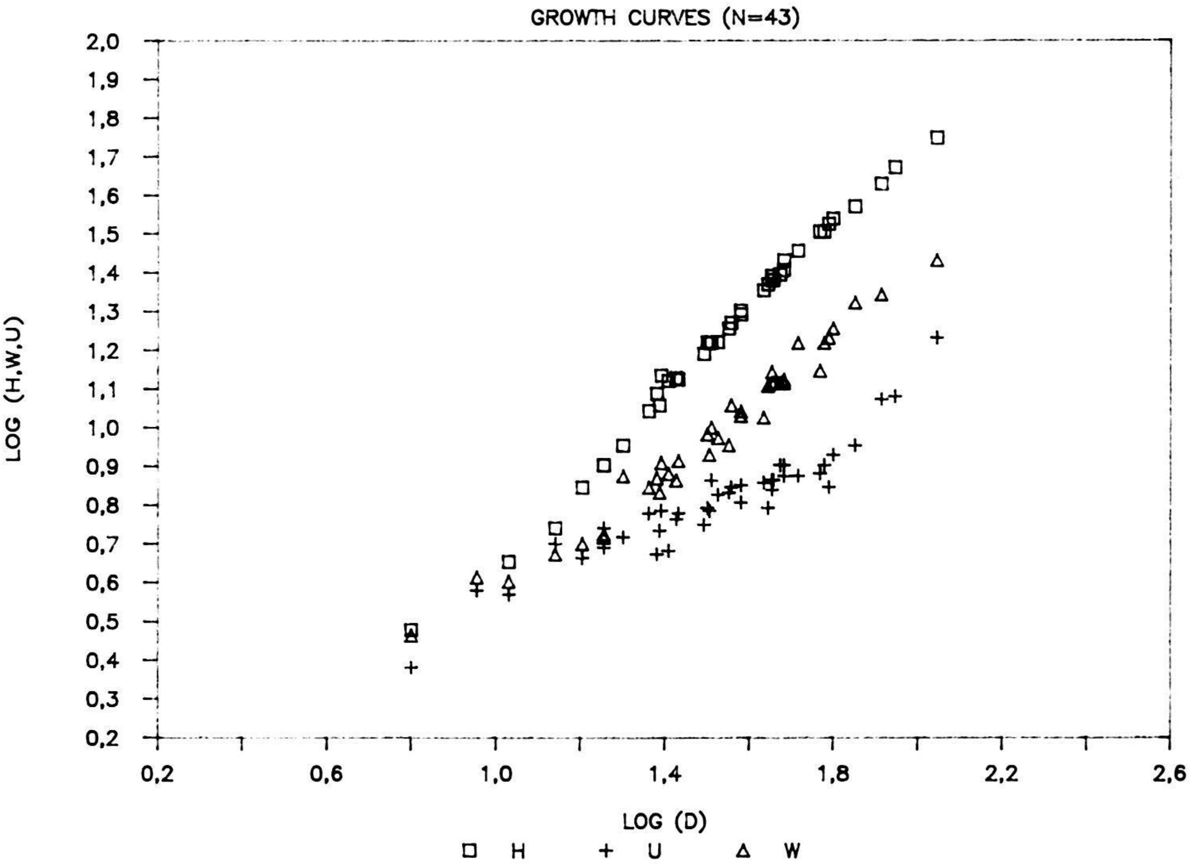

Fig. 6. Growth curves for 43 specimens of *Nicomedites*? *tozeri* n. sp. from locality HB 163 in the Escheri Beds of the *Taylori* Zone; Favret Canyon, Augusta Mnts. Squares = H; triangles = W; crosses = U.

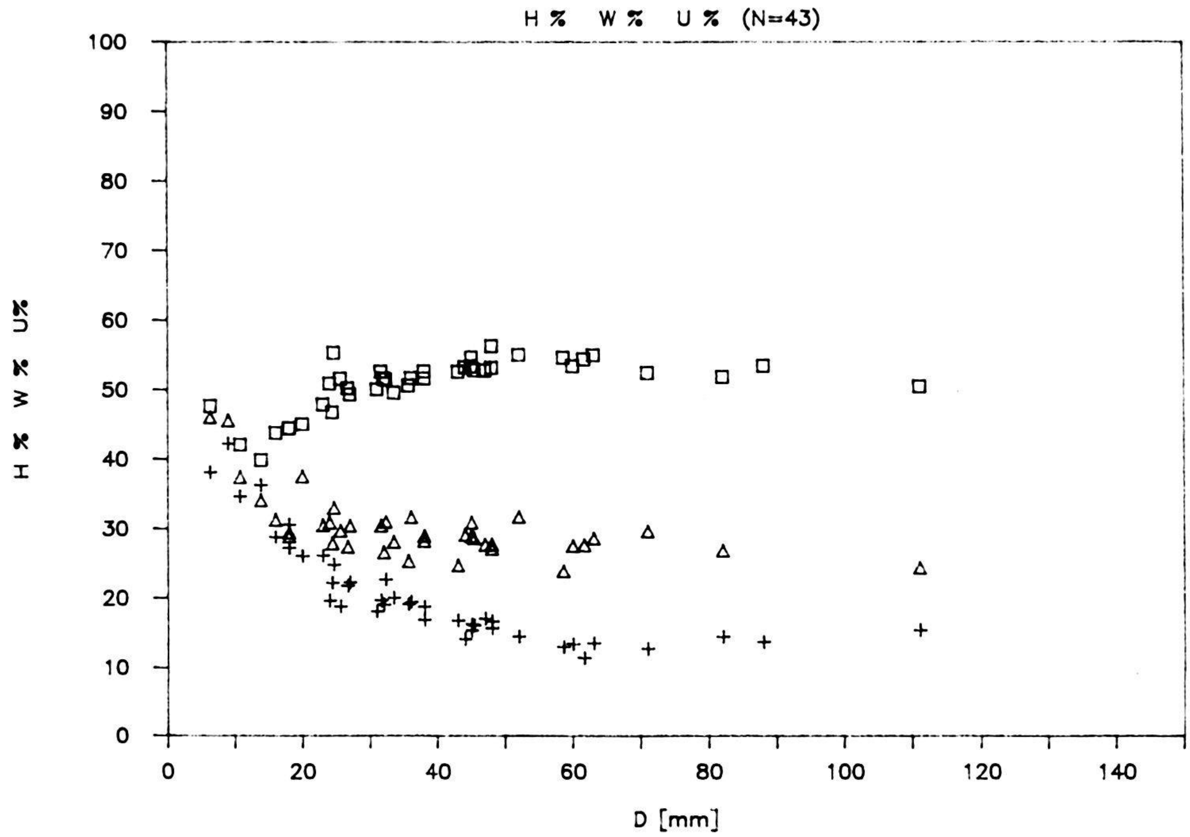

Fig. 7. Scatter diagram of H% (squares), W% (triangles), U% (crosses) against corresponding diameter for 43 specimens of *Nicomedites*? *tozeri* n. sp. from locality HB 163 in the Escheri Beds of the *Taylori* Zone; Favret Canyon, Augusta Mnts.

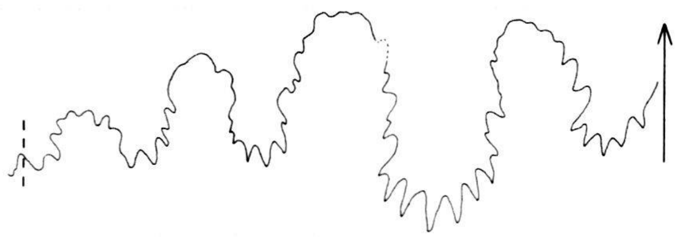

Fig. 8. Suture line (× 3) of *Nicomedites*? *tozeri* n. sp. at D = 41 mm. Plesiotype USNM 427980 (specimen not figured). Loc. HB 14 (single float block), Escheri Beds, *Taylori* Zone; Favret Canyon, Augusta Mnts.

Discussion. – Compared with *Nicomedites*? *moderatus* (McLearn 1948) that occurs in the Upper *Hyatti* Zone, *Nicomedites*? *tozeri* is more involute, with a more discoidal shape and a narrower venter. *N.*? *tozeri* has a similar but weaker ornamentation on the inner whorls but differs mainly by acquisition of a subfalcate pattern on outer whorls and body chamber. *N.*? *tozeri* also reaches a much larger mature size. At a comparable stage of growth, umbilical saddles of *N.*? *tozeri* are not as elongated as those of *N.*? *moderatus*.

Although *N.*? *moderatus* and *N.*? *tozeri* are provisionally referred to *Nicomedites*, generic attribution is uncertain. Both could belong to distinct lineage, somewhat younger than true *Nicomedites* from the *Osmani* Zone (see Figure 1). After Toula (1896), Artha-

BER (1914), SPATH (1934) and personal sampling of the *Osmani* Zone at its type locality, it results that the diagnostic features of *Nicomedites osmani* TOULA 1896 (type species of the genus) are the absence of umbilical and marginal tuberculation, an oval whorl section with divergent inner flanks and convergent outer flanks, a low arched to subtabulate venter bordered by slightly angular, smooth ventral shoulders. Ribbing is at first prosiradiate on inner flanks and is then rectiradiate on outer flanks, the bending point being located at midflanks. Ribs reach their maximal elevation at midflanks or slightly below. Suture line of *Nicomedites osmani* differs from those of the *moderatus-tozeri* group in having slightly phylloid divergent tips on lateral and first umbilical saddles, a narrower lateral lobe with less numerous but deeper identations and a shallower ventral lobe.

A third group of *Nicomedites*-like beyrichitids is represented by *"Aspidites" toulai* ARTHABER 1914 [= *Nicomedites toulai* (ARTHABER), SPATH 1934, not Pl. 18, Fig. 3; *Nicomedites* cf. *N. toulai* (ARTHABER), Tozer 1972a, Pl. 10, Fig. 14] which is recorded from the Ismidicus Zone (see Figure 1). This peculiar group is characterized by an acute trigonal whorl section, a rather tabulate and narrow venter, a very narrow umbilicus, a strongly reduced ribbing that only persists on midflanks and a suture line with a remarkably slender and deeply indented lateral saddle.

The whole of these differences could justify generic distinctions between the *moderatus-tozeri* group, the *osmani-barbarossae* group and the *toulai* group. Nevertheless, further detailed investigations on these superficially monotonous beyrichitids are still to be done.

It is also worth noting that the single specimen of *Nicomedites* known from the Lower *Hyatti* Zone (SILBERLING & NICHOLS 1982, Pl. 6, Fig. 9–10) is probably more closely allied to the *N. osmani* group than to the other ones.

Species named for E.T. Tozer of the Geological Survey of Canada, Ottawa.

Figured specimens. – Holotype USNM 427247, syntype USNM 427245, plesiotype USNM 427246.

Occurrence. – HB 163 (49), HB 175 (12), HB 173 (7), HB 14 (13), HB 105 (8), HB 189 (4), HB 200 (6), HB 164 (2), HB 195 (1), Favret Canyon, Augusta Mountains; Nevada. Escheri Beds, *Taylori* Zone, Middle Anisian.

Genus *Anagymnotoceras* MCLEARN 1966

Anagymnotoceras sp. A

Plate 4, Figures 17–18

Description. – A single distinctive immature specimen showing beginning of the body chamber comes into this provisional denomination. The phragmocone is relatively compressed, with a subrectangular whorl section. Umbilical tuberculation consists of low, radially elongated to higher, oblique bullae from which stem two ribs. Conspicuous crescentic marginal tuberculation present on the adoral rib which merge the much weaker adapical rib. On the ventral shoulder, both tuberculate and single intercalated ribs are projected. The venter is arched, smooth and crossed by projected fading ribs and growth lines. At the beginning of the immature body chamber, bullae are extremely radially elongated with their maximal elevation at midflanks. Marginal crescentic tubercles also disappear at this stage. At D = 29 mm, H = 40%, W = 31%, U = 33%. Suture line not known.

Discussion. – This is a somewhat intermediate form between *Anagymnotoceras* and *Eogymnotoceras* n. gen. Ornamentation is close to that of *Eogymnotoceras thompsoni* n. sp. but the non-keeled ventral pattern makes attribution to *Anagymnotoceras* more probable.

Figured specimen. USNM 427261.

Occurrence. – HB 179 (1), Favret canyon, Augusta Mountains; Nevada. *Anagymnotoceras* cf. *A. spivaki* Beds, *Taylori* Zone, Middle Anisian.

Anagymnotoceras cf. *A. spivaki* (McLearn 1946)

Plate 3, Figures 1–3, 6–9; Text-Figure 9

Hollandites? spivaki McLearn, 1946, p. 3, Pl. 5, Fig. 2; McLearn, 1948, p. 28, Pl. 5, Fig. 2.
Hollandites spivaki McLearn; Tozer, 1967, pp. 25, 70; McLearn, 1969, p. 17, Pl. 1, Fig. 11a, b.
? *Anagymnonotoceras moderatum* (McLearn); Silberling & Nichols, 1982, p. 25, Pl. 6, Fig. 7, 8.

Description. – Because intraspecific variability of various *Anagymnotoceras* described form British Columbia (McLearn 1969) is poorly known, specific identification of the few available specimens is difficult. Nevertheless, some specimens that apparently occur at constant stratigraphic level are tentatively assigned to *A. spivaki* (McLearn).

Small crescentic marginal tubercles on penultimate whorl is a peculiar character shared by the two most robust specimens (USNM 427249 & 427251).

On lower flanks, the mature body chamber bears weak, radially elongated bullae from which stem blunt ribs. Length of body chamber at least half of a whorl.

At D = 50–60 mm, H = 44–47%, W = 33–38%, U = 25–29%.

Suture line in close agreement with that of *Anagymnotoceras spivaki* (McLearn 1969, Fig. 5).

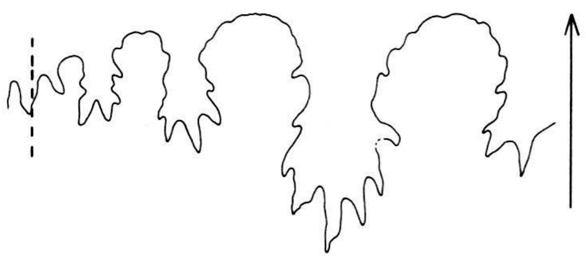

Fig. 9. Penultimate suture line (× 3) of *Anagymnotoceras* cf. *A. spivaki* (McLearn) at a diameter of about 38 mm. Plesiotype USNM 427249.

Discussion. – "*Anagymnotoceras moderatum*" (McLearn) as figured by Silberling & Nichols (1982, Pl. 6, Fig. 7, 8) is identical to the compressed variants included here into *Anagymnotoceras* cf. *A. spivaki*.

Figured specimens. – Plesiotypes USNM 427249, USNM 427250, USNM 427251.

Occurrence. – HB 1 (2), USGS loc. M2822 (2), North Humboldt Range; HB 101 (2), Favret Canyon, HB 197 (2), Muller Canyon, Augusta Mountains; Nevada. *Anagymnotoceras* cf. *A. spivaki* Beds, *Taylori* Zone, Middle Anisian.

Anagymnotoceras sp. C

Plate 3, Figures 4–5, 10–11; Text-Figure 10

Description. – Inner whorls relatively evolute, with a subquadrate section. Venter low, broadly arched and umbilical wall well rounded. Up to four ribs stem from high, radially elongated bullae. Growth lines strongly projected on venter. At D = 28 mm, H = 39%, W = 39%, U = 33%. Outer whorls much more involute and compressed, with evenly arched venter and high, perpendicular umbilical wall. Only two ribs branch from bullae.

The suture line generally conforms to that of other *Anagymnotoceras* but is distinctively finely identated.

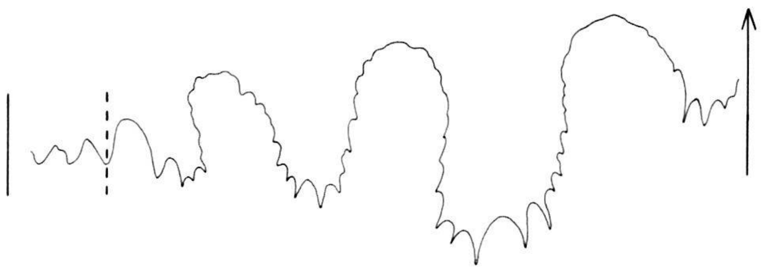

Fig. 10. Suture line (× 3) of *Anagymnotoceras* sp. C at H = 18 mm. USNM 427252.

Discussion. – This form does not clearly correspond to any known species of *Anagymnotoceras*. It also differs from the next underlying *Anagymnotoceras* cf. *A. spivaki* by having more evolute and more finely ribbed inner whorls. Outer whorls have comparatively less convergent flanks, with less marked ventral shoulders and a deeper umbilicus. A peculiar feature is shown by the suture line which is more finely frilled than that of other known *Anagymnotoceras*.

Figured specimens. – USNM 427252, USNM 427253.

Occurrence. – HB 156 (2), McCoy Mine, New Pass Range; Nevada. Escheri Beds, *Taylori* Zone, Middle Anisian.

Genus *Eogymnotoceras* n. gen.

Type species. – *Eogymnotoceras thompsoni* n. sp.

Description. – Thickly discoidal to moderately compressed, evolute to moderately involute beyrichitid, with umbilical tubercles or bullae and a more or less prominent rounded keel. Whorl section of phragmocone subrectangular to subtrapezoidal, with rounded umbilical wall and convex to subtabulate venter bordered by rounded to angular ventral shoulders. Falcoid ribbing, sharply projected between ventral shoulders and keel. On venter, ribs characteristically merge the keel at an angle of about 60°. Peripheral projection of growth lines follows the same path. Up to four ribs may stem from oblique, high to rounded umbilical tubercles. Both branched and intercalated ribs become larger when they reach the ventral shoulder thus forming a marginal tuberculation of variable strength. On inner whorls, crescentic auriculoids may develop on branched ribs just inside ventral shoulder.

Shape of mature body chamber variable but usually more involute and more compressed than phragmocone. The main kind has flattened flanks, slowly converging towards a high, subfastigate venter. Umbilical wall high and perpendicular. Rapid morphological transition of ornamentation shows that umbilical bullae fade and completely disappear without being shifted on midflanks. The only subsisting ornamentation is reduced to bundled striae or weak, broad sinuous folds on mid- and upper flanks. The other kind that already appears on end of phragmocone is strongly discoidal, with a subtrigonal, spear-shaped whorl section.

Composition of the genus. – *Eogymnotoceras thompsoni* n. sp., *E. transiens* n. sp., *E.* n. sp. A, [part] *E. deleeni* (McLearn 1946), *E. deleeni* var. *liardense* (McLearn 1946), *E. beachi* (McLearn 1946).

Discussion. – *Eogymnotoceras* is distinguished from *Anagymnotoceras* McLearn by its at least partly keeled phragmocone, its marginal tuberculation and its more compressed whorl shape. *Eogymnotoceras* differs from *Gymnotoceras* Hyatt by having a well developed umbilical tuberculation, a stronger ribbing and subrectangular instead of subtrigonal whorl section. *Eogymnotoceras* is distinguished from *Frechites* Smith by its less robust shape, its umbilical tuberculation that never enlarge into spines on midflanks, its narrower, convex to subfastigate venter. *Eogymnotoceras* differs from *Parafrechites* Silberling and Nichols (= ? *Frechitoides* Konstantinov 1987) by its more evolute coiling, its weaker keel, its stronger umbilical tuberculation and its subfastigate venter.

The name of this new genus suggests a possible phylogenetic origin for *Gymnotoceras* Hyatt.

Occurrence. – Escheri and Praebalatonensis Beds, *Taylori* Zone; Lower *Shoshonensis* Zone; Middle Anisian, Nevada. *Deleeni* Zone, early Upper Anisian, British Columbia.

Remark. – Because *Eogymnotoceras* n. sp. A ranges only through the Lower *Shoshonensis* Zone, this species will be described separately.

Eogymnotoceras thompsoni n. sp.

Plate 4, Figures 1–16; Plate 5, Figures 10–11; Text-Figure 13

Description. – *Eogymnotoceras* showing a wide range of variation. Phragmocone of average variants bears auriculoids just below ventral shoulder. This conspicuous ornamentation starts at D = 10–15 mm and may last up to D = 40 mm among the most robust variants, or may be absent among the more compressed ones. Carination may also extend to the end of phragmocone on robust variants or is reduced to inner whorls on compressed ones. Tuberculation and ribbing vary the same way and range from low radially elongated bullae from which stem only two faint ribs to strong, usually oblique tubercles from which stem up to four strong ribs. Mature body chamber corresponds to the main kind as described in the generic definition. Growth curves, H%, W% and U% are respectively plotted on Figures 11 and 12. Suture line subammonitic, close to that of *Anagymnotoceras* but with a wider and more indented first lateral lobe.

Discussion. – Distinguished from *Eogymnotoceras transiens* n. sp. by its weaker ornamentation on inner whorls, its weaker keel and its subtrapezoidal to subrectangular outer whorl section. The wide range of variation of *Eogymnotoceras thompsoni* partially overlaps forms such as *"Gymnotoceras" deleeni* (McLearn 1969, Pl. 4, Fig. 2 to 6, [not] Pl. 5, Fig. 5), *"Gymnotoceras" deleeni* var. *liardense* (ibid. Pl. 5, Fig. 3, 4) and *"Gymnotoceras" beachi* (ibid., Pl. 5, Fig. 1). However, none of these species listed from British Columbia fits with the robust and evolute variants included here into *Eogymnotoceras thompsoni*. In addition, all of McLearn's species are slightly more involute than average variants of *Eogymnotoceras thompsoni*. It equally seems preferable to make a specific distinction because variability of forms from British Columbia is not adequately known.

Eogymnotoceras thompsoni differs from *Eogymnotoceras* n. sp. A by its less pronounced tuberculation and ribbing, also by a weaker carination and less well marked ventral shoulders.

Species named for W. M. Thompson, Winnemucca, Nevada.

Figured specimens. – Holotype USNM 427255, syntype USNM 427258, plesiotypes USNM 427254, USNM 427256, USNM 427257, USNM 427259.

Occurrence. – HB 14 (1), HB 105 (24), HB 163 (23), HB 173 (31), HB 175 (38), HB 176 (3), HB 185 (1), HB 189 (3), HB 195 (1), HB 200 (3), HB 214 (1), HB 216 (1), Favret Canyon and Muller Canyon, Augusta Mountains; HB 156 (1), McCoy Mine; HB 218 (2), South Canyon, New Pass Range; HB 36 (52), North Humboldt Range; Nevada. Escheri Beds, *Taylori* Zone, Middle Anisian.

Eogymnotoceras transiens n. sp.

Plate 5, Figures 4–9; Plate 6, Figures 8–10

Description. – *Eogymnotoceras* with each ontogenetic stage having a very variable duration. Inner whorls usually quadrangular, with high rounded umbilical tubercles from which stem up to three stout ribs. These enlarge when passing on ventral shoulder and are strongly projected on a low, convex venter. Keel well individualized and rounded. Outer whorls rapidly change into a subtrigonal, spear-shaped whorl section. Umbilicus narrows and whorl height increases remarkably. Umbilical tuberculation fades simultaneously and thus rapidly disappears. Branched and intercalated ribs weaken but are evenly projected on the acutely rounded venter. The keel lasts comparatively longer than the early ornamental stage but gradually loses its strength. Mature body chamber not known.

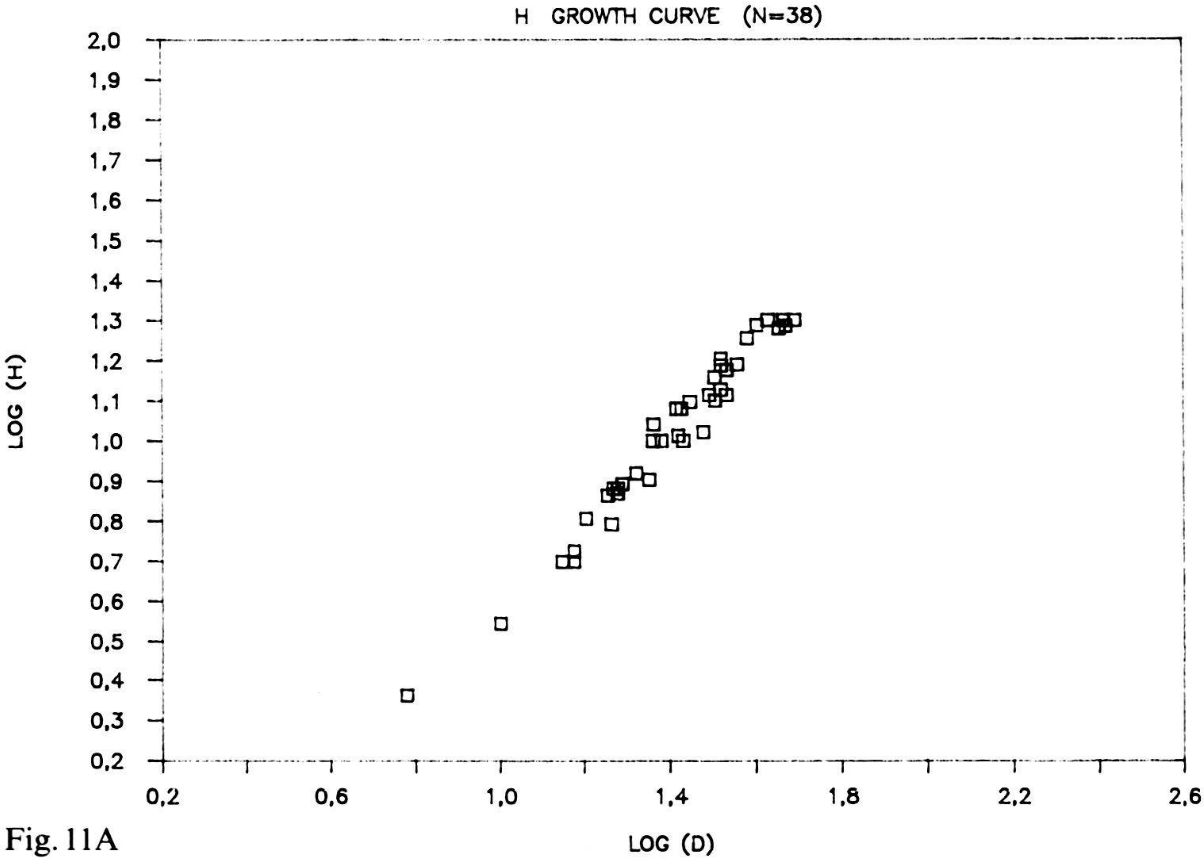

Fig. 11A

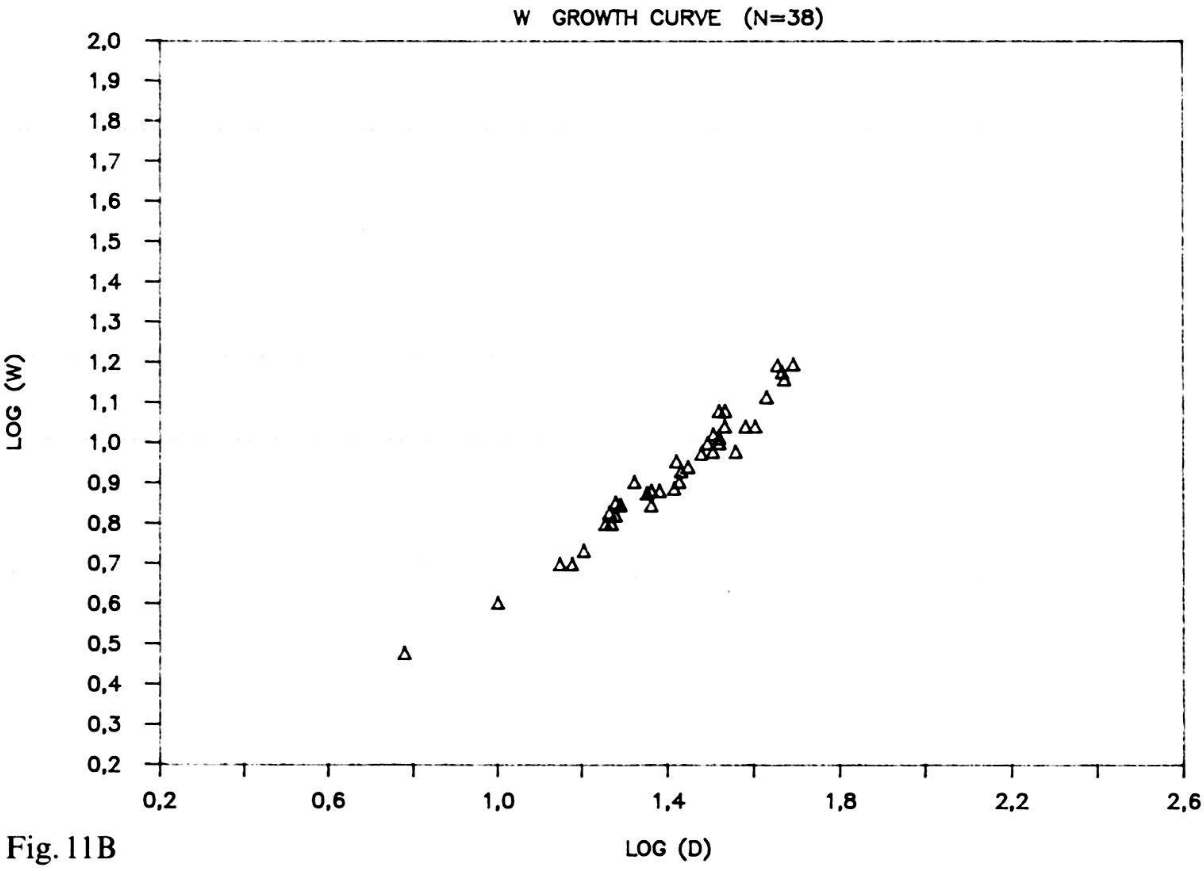

Fig. 11B

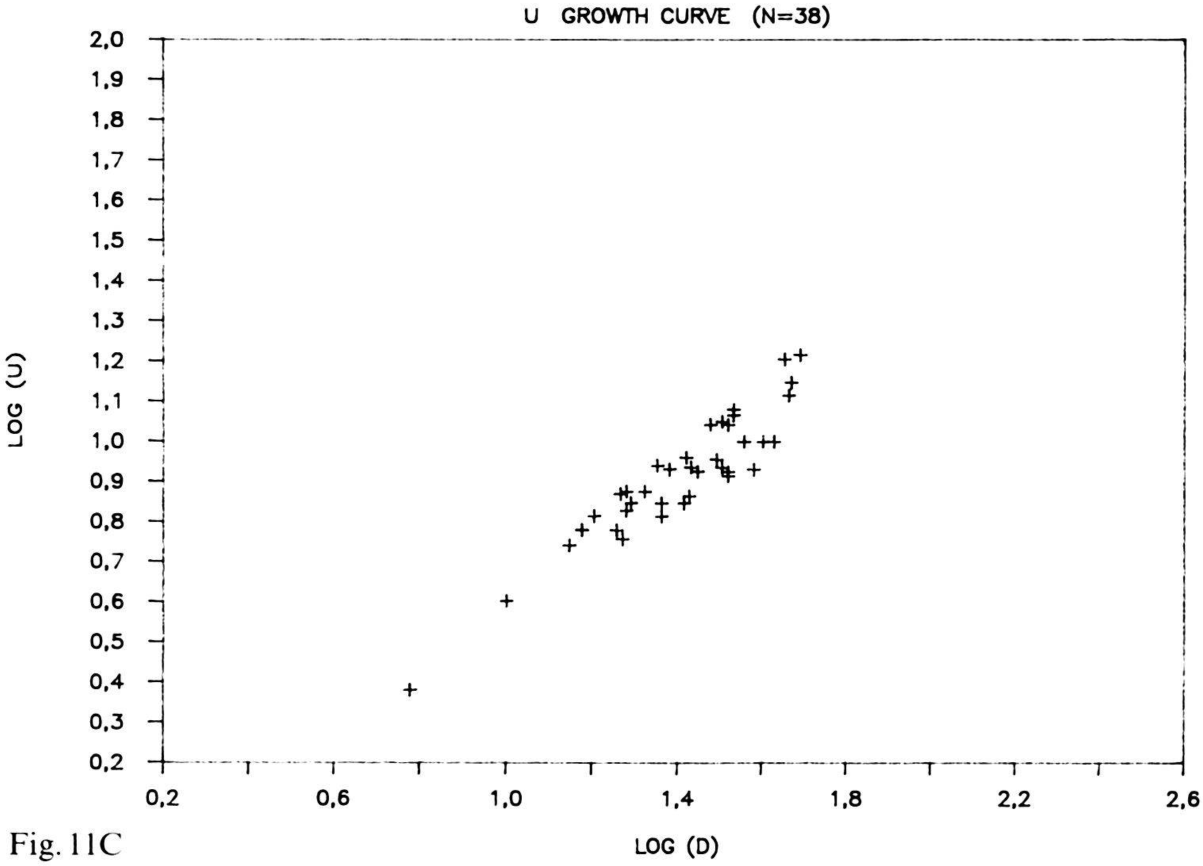

Fig. 11C

Fig. 11. Growth curves for 38 specimens of *Eogymnotoceras thompsoni* n. gen. n. sp. from locality HB 175 in the Escheri Beds of the *Taylori* Zone; Favret Canyon, Augusta Mnts. A: Height growth curve. B: Width growth curve. C: Umbilical width growth curve.

The holotype (a full grown phragmocone) has a diameter of 69 mm, at which H = 53%, W = 32%, U = 16%; immature specimens of about 20 mm of diameter have H = 41%, W = 31%, U = 35%.

Suture line subammonitic, with a low first lateral saddle and three umbilical saddles, but too poorly preserved to be drawn.

Discussion. – This species appears to be transitional between *Eogymnotoceras* n. gen. and *Gymnotoceras* HYATT. Generic attribution to the former results from the characteristic pattern of inner whorls. Special mention must be made here that both genera occur together in the Lower *Shoshonensis* Zone where their morphological differentiation is fully achieved.

Species name reflects the supposed transitional pattern between *Eogymnotoceras* n. gen. and *Gymnotoceras* HYATT.

Figured specimens. – Holotype USNM 427264, syntypes USNM 427262, USNM 427263.

Occurrence. – HB 170 (2), HB 162 (10), Favret Canyon, Augusta Mountains; Nevada. Praebalatonensis Beds, *Taylori* Zone, Middle Anisian.

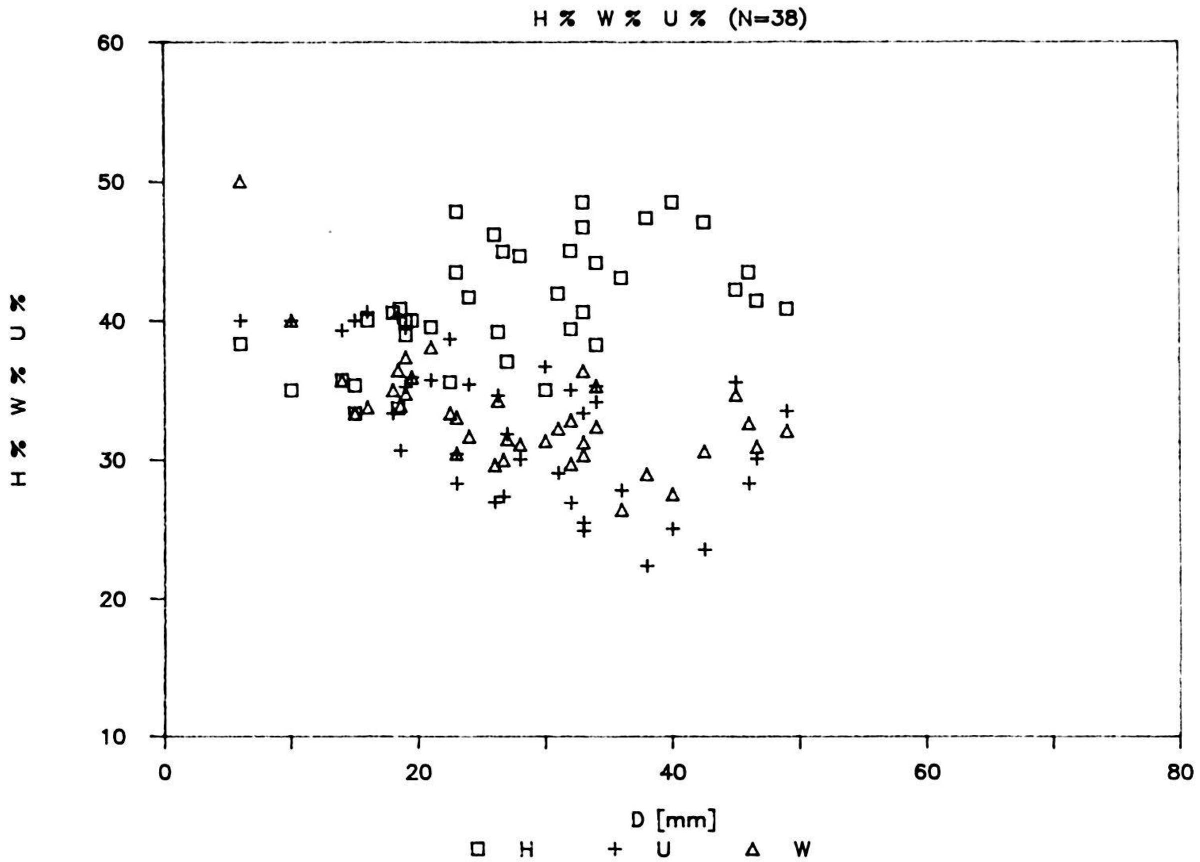

Fig. 12. Scatter diagram of H% (squares), W% (triangles), U% (crosses) against corresponding diameter for 38 specimens of *Eogymnotoceras thompsoni* n. gen. n. sp. from locality HB 175 in the Escheri Beds of the *Taylori* Zone; Favret Canyon, Augusta Mnts.

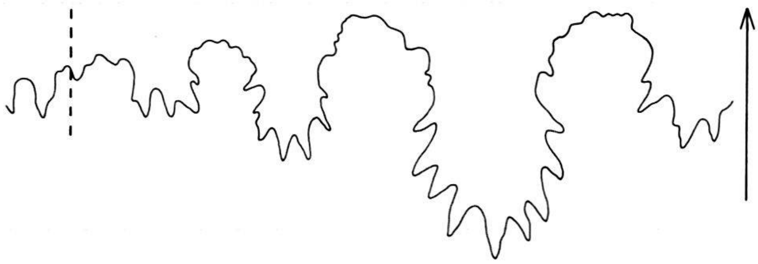

Fig. 13. Last suture line (× 3) of *Eogymnotoceras thompsoni* n. gen. n. sp. at D = 46 mm. Plesiotype USNM 427981 (specimen not figured). Loc. HB 189, Escheri Beds, *Taylori* Zone; Favret Canyon, Augusta Mnts.

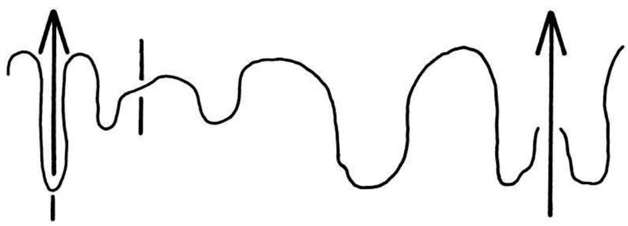

Fig. 14. Suture line (× 6) of *Pseudodanubites nicholsi* n. sp. at H = 5 mm. Syntype USNM 427982 (specimen not figured). Loc. HB 30, Nicholsi Beds, *Taylori* Zone; North Fork of Straight Canyon, North Humboldt Range.

Superfamily ***Danubitaceae*** SPATH 1951

Family ***Danubitidae*** SPATH 1951

Genus *Pseudodanubites* HYATT 1900

Pseudodanubites nicholsi n. sp.

Plate 2, Figures 10–12; Plate 6, Figures 1–2; Text-Figure 14

Description. – Extremely serpenticone and small sized *Pseudodanubites* with weak ribbing. Inner whorls have a subquadrate section with an arched venter and a well-rounded umbilical margin. Gradual change in the shape of the outer whorls and body chamber is produced by more evolute coiling, steeper umbilical margin and further arching of the venter into a fastigate shape. Ornamentation is reduced to a blunt, more or less plicate ribbing on flanks of inner whorls. Constriction-like narrowings (up to three per whorl) are emphasized by bulging of the rib bordering their adoral side. Venter remains smooth on inner whorls. On outer whorls and body chamber, the ribs tend to cross the venter with decreasing strength and the "constrictions" do not fully interrupt the siphonal elevation. At a diameter of 35 mm (body chamber of the holotype), H = 22%, W = 22% and U = 62%.

Suture line very simple, with smooth lobes; respective proportions of lobes and saddles are identical to these of *Pseudodanubites halli* (MOJSISOVICS) 1896.

Discussion. – *Pseudodanubites nicholsi* is probably closely related to *Pseudodanubites halli* that occurs in the next underlying beds (Upper *Hyatti* Zone). Compared to *P. halli, P. nicholsi* differs by a smaller mature size, a more evolute coiling and a much weaker ribbing. The suture line is also simplified by loss of crenulation on both lobes and saddles.

This new species is named for K. M. Nichols of the U.S. Geological Survey, Denver.

Figured specimens. – Holotype USNM 427248, plesiotype USNM 427268.

Occurrence. – HB 30 (4), HB 68 (2), HB 47 (1), HB 28 (1), HB 29 (1), North Humboldt Range; HB 99 (1), HB 215 (3), Favret Canyon, Augusta Mountains; Nevada. Nicholsi Beds, *Taylori* zone, Middle Anisian.

Superfamily ***Ptychitaceae*** MOJSISOVICS 1882

Family ***Isculitidae*** SPATH 1951

Genus *Nevadisculites* n. gen.

Type species. – *Nevadisculites taylori* n. sp.

Description. – Extremely involute isculitid with a steeply excentrumbilicate and an occasionally contracted last volution. Egression only affects a fourth to a third of the ultimate whorl. At the start of body chamber, umbilicus gets narrower and thickened umbilical walls may even meet but do not weld. Umbilical deposit (TOZER 1972b) is apparently absent. End of body chamber bears a weak peristomal collar. Length of body chamber about two whorls. Shell and internal mold are smooth, without constrictions. Growth striae are slightly prosiradiate.

Suture line ammonitic, with relatively slender and elongated elements. Degree of crenulation depends on final mature size, the larger species having a more indented suture line. Up to three auxiliary elements may develop. In its general outline, the suture line of *Nevadisculites* conforms to that of isculitids.

Composition of the genus. – *Nevadisculites taylori* n. sp., *N. smithi* n. sp., *N. herminae* (DIENER) 1913 = nov. gen. ind. ex fam. *Arcestidarum* sp. ind. DIENER 1895, *"Smithoceras"* sp. indet. DIENER 1913, *N. cyclindroides* (ARTHABER 1914).

Discussion. – The status of *Isculidtidae* was clarified by SPATH (1951), mainly on the basis of their suture lines. He distinguished this family from paranannitids, ptychitids, arcestids and haloritids and showed them to be restricted to the Anisian stage. From previous authors, he also inherited a rather confused taxonomy regarding the few genera he included into his new family. This was mainly due to the poor knowledge of body chambers workers had at that time. It now appears that characteristics of the mature body chambers are of prime importance for generic distinction among isculitids.

Distinctive characteristics of *Isculites* MOJSISOVICS 1886 are a slowly egressive umbilical suture that affects part (at least half of a whorl) if not all of the body chamber. The length of the body chamber is about one and half whorls. This genus has a more or less tightened funnel-shaped umbilicus. *Isculites* commonly bears shallow constrictions that are only visible on internal mold of phragmocone, however they rarely occur on the beginning of the body chamber of some fully grown specimens. At mature stage, the degree of crenulation of suture lines largely depends on adult size which means that dwarf or small sized species have comparatively fewer frills on the ultimate suture line than the large ones. Although present, the third auxiliary element does not fully develop, even at mature stage.

The type species of *Isculites* is *I. hauerinus* (STOLICZKA) = *Spitisculites hauerinus* in DIENER 1916.

Because the type species of *Smithoceras* DIENER 1907 (*S. drummondi* DIENER 1907) conforms to *Isculites* as defined above, *Smithoceras* is here partly regarded as a synonym of *Isculites*. On one hand, the following species are thus attributed to *Isculites: I. hauerinus* (STOLICZKA 1865), *I. meeki* (HYATT & SMITH 1905) = *Alloptychites meeki* in Spath 1951, *I. drummondi* (DIENER 1907), *I. middlemissi* DIENER 1913, *I.* sp. indet. TOZER 1973, *I. tozeri* SILBERLING & NICHOLS 1982.

On the other hand, *Smithoceras herminae* DIENER, *Smithoceras* sp. indet DIENER and *Ptychites? cylindroides* ARTHABER are probably closely allied to *Nevadisculites*.

Generic attribution of *"Smithoceras" sphaericum* SHEVYREV 1968 is still unclear. This form only differs from *Isculites* by its suture line which has up to four auxiliary elements, a peculiar feature rarely encountered among isculitids.

Isculites sp. ind. (I) DIENER 1913 and *Isculites* sp. ind. (II) DIENER 1913 are too poorly known for unambiguous generic attribution.

Occurrence. – Lower *Hyatti* Zone to Middle *Shoshonensis* Zone, Middle Anisian, Nevada. "Upper Muschelkalk", Shalshal Cliff, Central Himalaya, India (DIENER 1895). Lower Gymnites layer, "Upper Muschelkalk", Kashmir, India (DIENER 1913). Gebze, Turkey, exact occurrence not known but probably Middle Anisian (ARTHABER 1914).

Nevadisculites taylori n. sp.

Plate 6, Figures 3–7; Text-Figures 15–16

Description. – Large sized *Nevadisculites* with an arched to subfastigate venter on last half whorl of the body chamber. The ventral part of the aperture itself is again well rounded with a slight bulging of the shell that covers the shallow apertural collar. Otherwise, the rest of the body chamber has a semicircular ventral outline. On the first whorl of body chamber, thickened umbilical margins meet but do not weld. Length of body chamber about two whorls. Phragmocone commonly even more depressed than body chamber and with a very narrow umbilicus. The largest full grown specimen has a

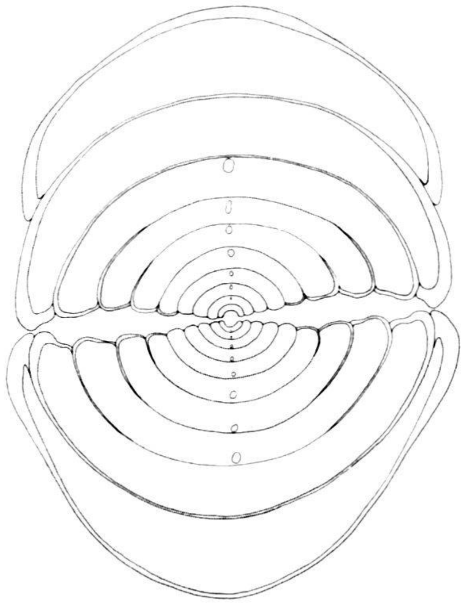

Fig. 15. Section (× 1.5) of a complete mature specimen of *Nevadisculites taylori* n. gen. n. sp. Plesiotype USNM 831248 (specimen not figured). Loc. HB 200 (single float block), Escheri Beds, *Taylori* Zone; Favret Canyon, Augusta Mnts.

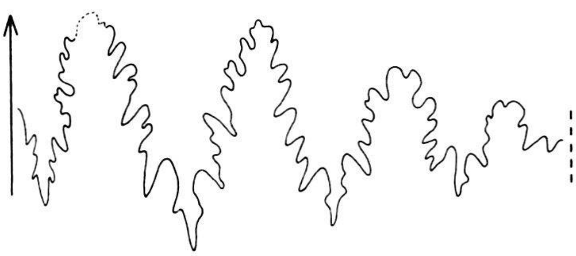

Fig. 16. Suture line (× 3) of *Nevadisculites taylori* n. gen. n. sp. at D = 25 mm. Plesiotype USNM 427983 (specimen not figured). Loc. HB 14 (single float block), Escheri Beds, *Taylori* Zone; Favret Canyon, Augusta Mnts.

maximal diameter of 60 mm. H = 50% and W = 76% just before egression of the umbilical margin of the holotype which is a relatively compressed specimen. Extreme values measured the same way range from H = 49 to 54% and W = 70 to 90%.

Discussion. – *N. taylori* differs from *N. smithi* n. sp. by its larger size and its more depressed body chamber; also by the presence of a subfastigate venter on part of the body chamber and a shallower apertural collar. Mature suture line is distinguished by more finely indented saddles and narrower lateral and umbilical lobes.

This species is named for D. G. Taylor of the Portland State University.

Figured specimens. – Holotype USNM 427267, plesiotype USNM 427266.

Occurrence. – HB 179 (2), HB 100 (2), HB 14 (1), HB 99 (1), HB 216 (2), HB 163 (11), HB 200 (3), HB 189 (2), HB 185 (5), HB 105 (9), HB 173 (5), HB 163 (9), HB 162 (3), HB 164 (1), HB 165 (1), HB 175 (6), HB 214 (1), USGS loc. M 701 A (2), Favret Canyon, Augusta Mountains; HB 195 (1), Muller Canyon, Augusta Mountains; HB 217 (1), HB 148 (7), HB 113 (3), Southern Tobin Range; HB 218 (1), South Canyon, New Pass Range; HB 48 (3), HB 36 (2), HB 27 (1), HB 144 (2), North Humboldt Range; Nevada. *Anagymnotoceras* cf. *A. spivaki*, Escheri and Praebalatonensis Beds, *Taylori* Zone, Middle Anisian.

Nevadisculites smithi n. sp.

Plate 5, Figures 1–3; Text-Figure 17–18

Description. – Small sized *Nevadisculites,* with a globose phragmocone and a relatively compressed body chamber. The venter has a semicircular outline on phragmocone and is arched on body chamber. The apertural collar is well pronounced. Just before egression, average values are H = 52% and W = 70% whereas the holotype has the ratios H = 58%

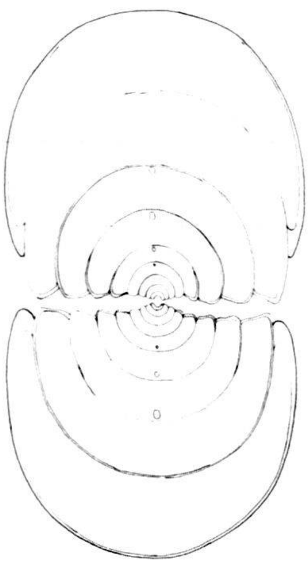

Fig. 17. Section (× 2) of a complete mature specimen of *Nevadisculites smithi* n. gen. n. sp. Plesiotype USNM 831249 (specimen not figured). Loc. HB 174, Middle *Shoshonensis* Zone; Favret Canyon, Augusta Mnts.

and W = 70%. The largest specimen has a diameter of about 32 mm. The third auxiliary element does not develop, even on mature suture lines.

Discussion. – The smaller mature size, the permanent well rounded venter, the wider apertural collar and the less frilled suture line enable making a specific distinction with the type species.

N. smithi is named in honor of J. Perrin Smith.

Figured specimen. – Holotype USNM 427265.

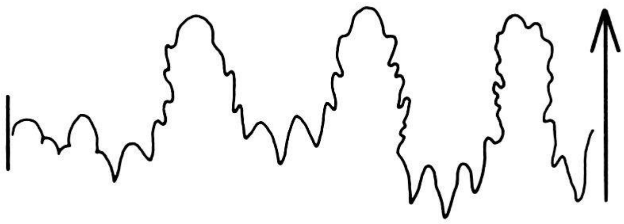

Fig. 18. Penultimate suture line (× 6) of *Nevadisculites smithi* n. gen. n. sp. at D = 9 mm. Plesiotype USNM 427984 (specimen not figured). Loc. HB 187, Middle *Shoshonensis* Zone; Favret Canyon, Augusta Mnts.

Occurrence. – HB 30 (6) North Humboldt Range; HB 14 (1), HB 99 (1), HB 105 (1), HB 173 (2), Favret Canyon, Augusta Mountains, Nevada. Nicholsi, *Anagymnotoceras* cf. *A. spivaki* and Escheri Beds, *Taylori* Zone, Middle Anisian (occurrences from *Hyatti* and *Shoshonensis* Zones not listed).

Acknowledgment

Fieldwork and laboratory research was funded by project N° 2.565-0.84 of the Swiss National Foundation for Scientific Research. The author is greatly indebted to E.T. Tozer, N.J. Silberling, K.M. Nichols and J. Guex for their generous help and reviewing. Unpublished data from Spiti were made available by L. Krystyn. Enthusiasm and hospitality of Mrs. P. Trego during fieldwork were deeply appreciated.

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Manuscript received and accepted 27 June 1988

Plate 1

All figures natural size

Fig. 1–3, 7–8, 14–15 *Augustaceras escheri* n. gen. n. sp. Escheri beds, *Taylori* Zone. 1–3: holotype, USNM 427235, loc. HB 175, Favret Canyon, Augusta Mnts. 7–8: plesiotype, USNM 427236, loc. HB 105, Favret Canyon, Augusta Mnts. 14–15: plesiotype, USNM 427237, loc. HB 156, McCoy Mine, New Pass Range.

Fig. 4–6 *Platycuccoceras praebalatonensis* n. gen. n. sp. Praebatatonensis Beds, *Taylori* Zone. Syntype, USNM 427242, loc. HB 170, Favret Canyon, Augusta Mnts.

Fig. 9–13 *Augustaceras staffordi* n. gen. n. sp. Escheri Beds, *Taylori* Zone. 9–10: plesiotype, USNM 427238, loc. HB 165, Favret Canyon, Augusta Mnts. 11–13: holotype, USNM 427239, loc. HB 185, Favret Canyon, Augusta Mnts.

Fig. 16–20 *Platycuccoceras favretense* n. gen. n. sp. Escheri Beds, Taylori Zone. 16–18: syntype, USNM 427240, loc. HB 14, Favret Canyon, Augusta Mnts. 19–20: holotype, USNM 427241, loc. HB 14, Favret Canyon, Augusta Mnts.

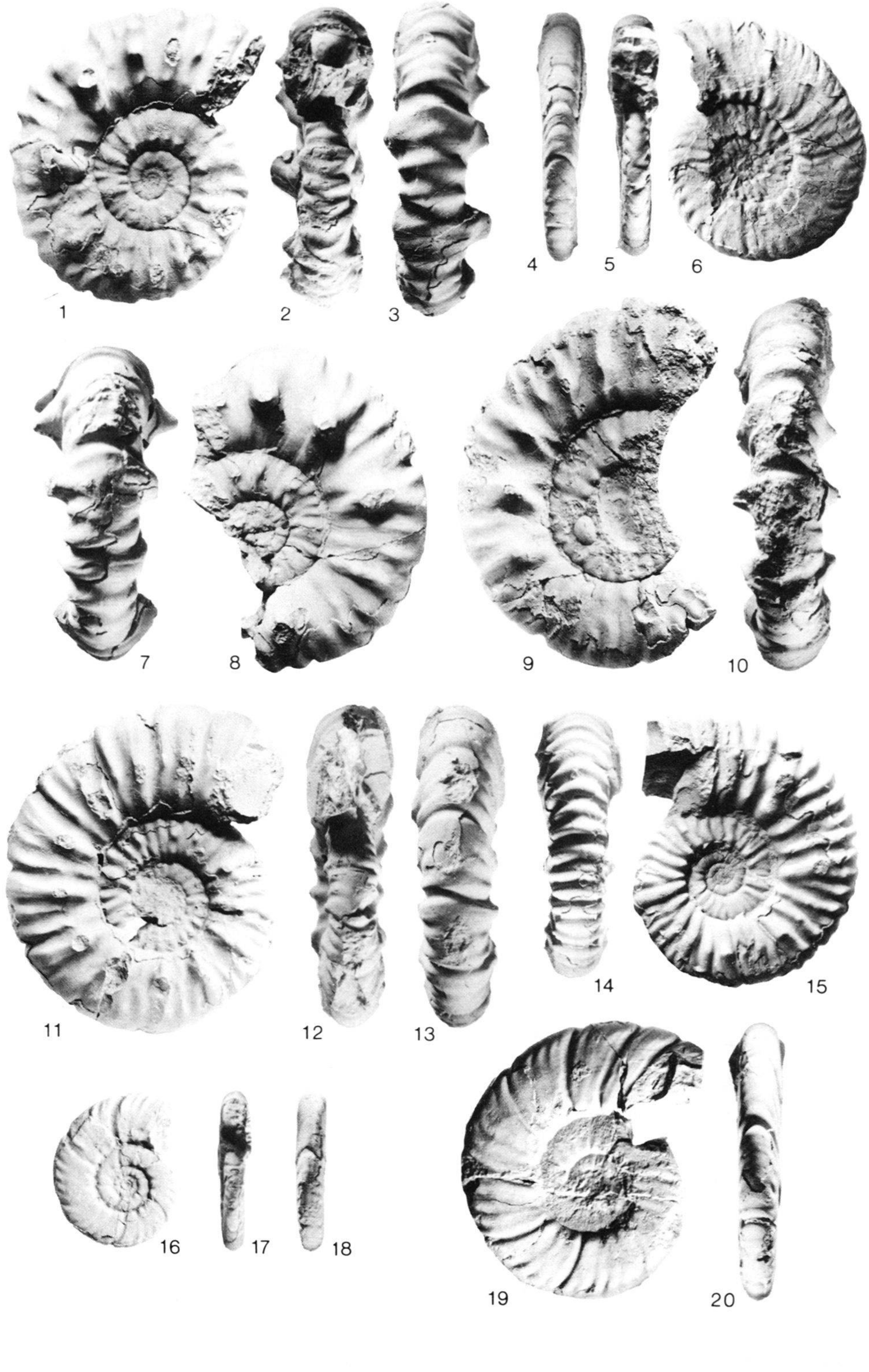
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Plate 2

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Fig. 1–4 *Platycuccoceras praebalatonensis* n. gen. n. sp. Praebalatonensis Beds, *Taylori* Zone. 1–2: holotype, USNM 427243, loc. HB 170, Favret Canyon, Augusta Mnts. 3–4: syntype, USNM 427244, loc. HB 170, Favret Canyon, Augusta Mnts.

Fig. 5–9 *Nicomedites*? *tozeri* n. sp. Escheri Beds, *Taylori* Zone. 5–6: syntype, USNM 427245, loc. HB 175, Favret Canyon, Augusta Mnts. 7: plesiotype, USNM 427246, loc. HB 189, Favret Canyon, Augusta Mnts. 8–9: holotype, USNM 427247, loc. HB 175, Favret Canyon, Augusta Mnts.

Fig. 10–12 *Pseudodanubuites nicholsi* n. sp. Nicholsi Beds, *Taylori* Zone. Holotype, USNM 427248, loc. HB 30, North Fork of Straight Canyon, North Humboldt Range.

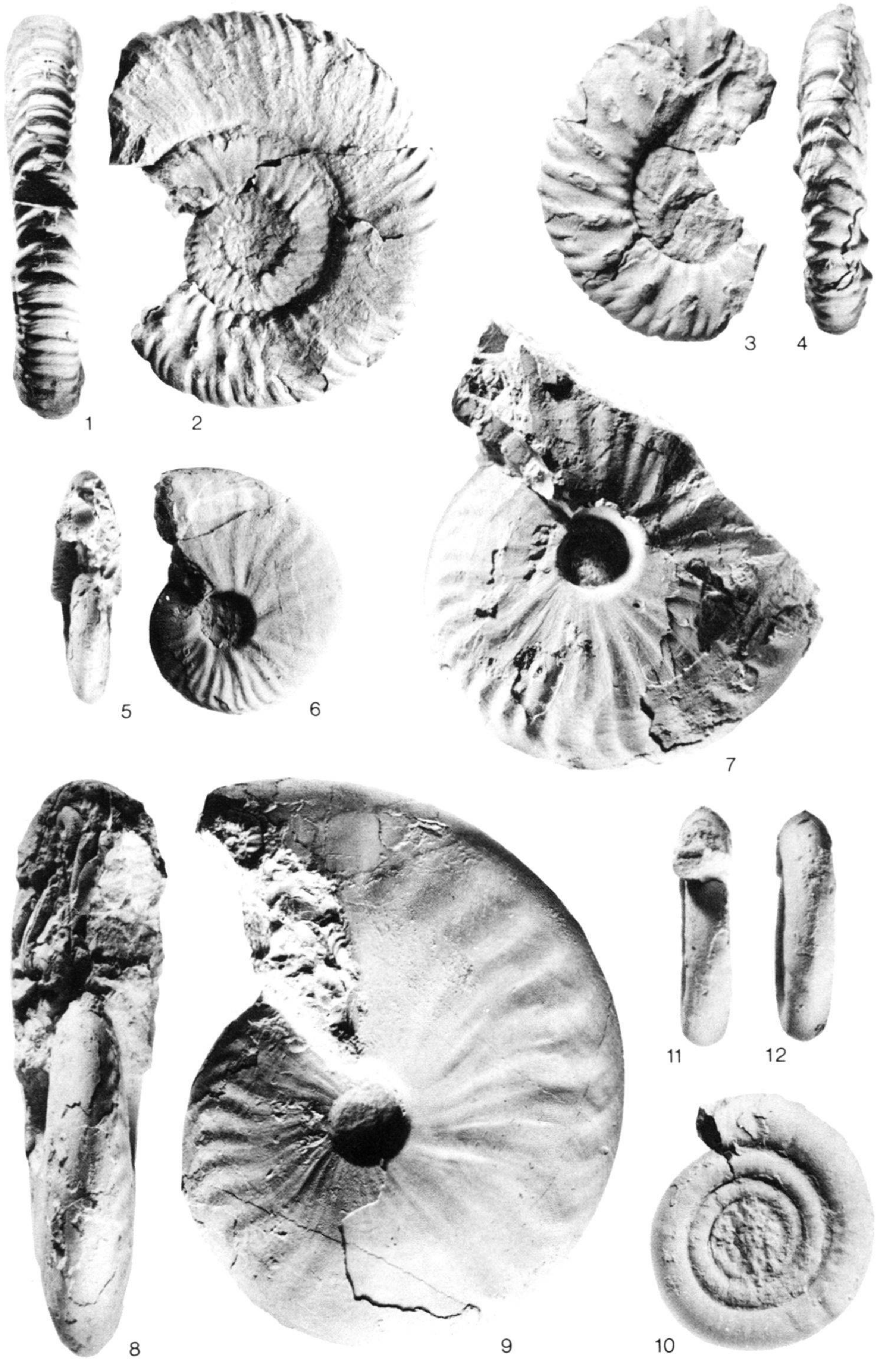
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Plate 3

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Fig. 1–3, 6–9 *Anagymnotoceras* cf. *A. spivaki* (McLearn 1946). *Anagymnotoceras* cf. *A. spivaki* Beds, *Taylori* Zone. 1–3: plesiotype, USNM 427249, loc. HB 197, Muller Canyon, Augusta Mnts. 6–7: plesiotype, USNM 427250, loc. HB 197, Muller Canyon, Augusta Mnts. 8–9: plesiotype, USNM 427251, loc. HB 1, John Brown Canyon, North Humboldt Range.

Fig. 4–5, 10–11 *Anagymnotoceras* sp. C. Escheri Beds, *Taylori* Zone. 4–5: plesiotype, USNM 427252, loc. HB 156, McCoy Mine, New Pass Range. 10–11: plesiotype, USNM 427253, loc. HB 156, McCoy Mine, New Pass Range.

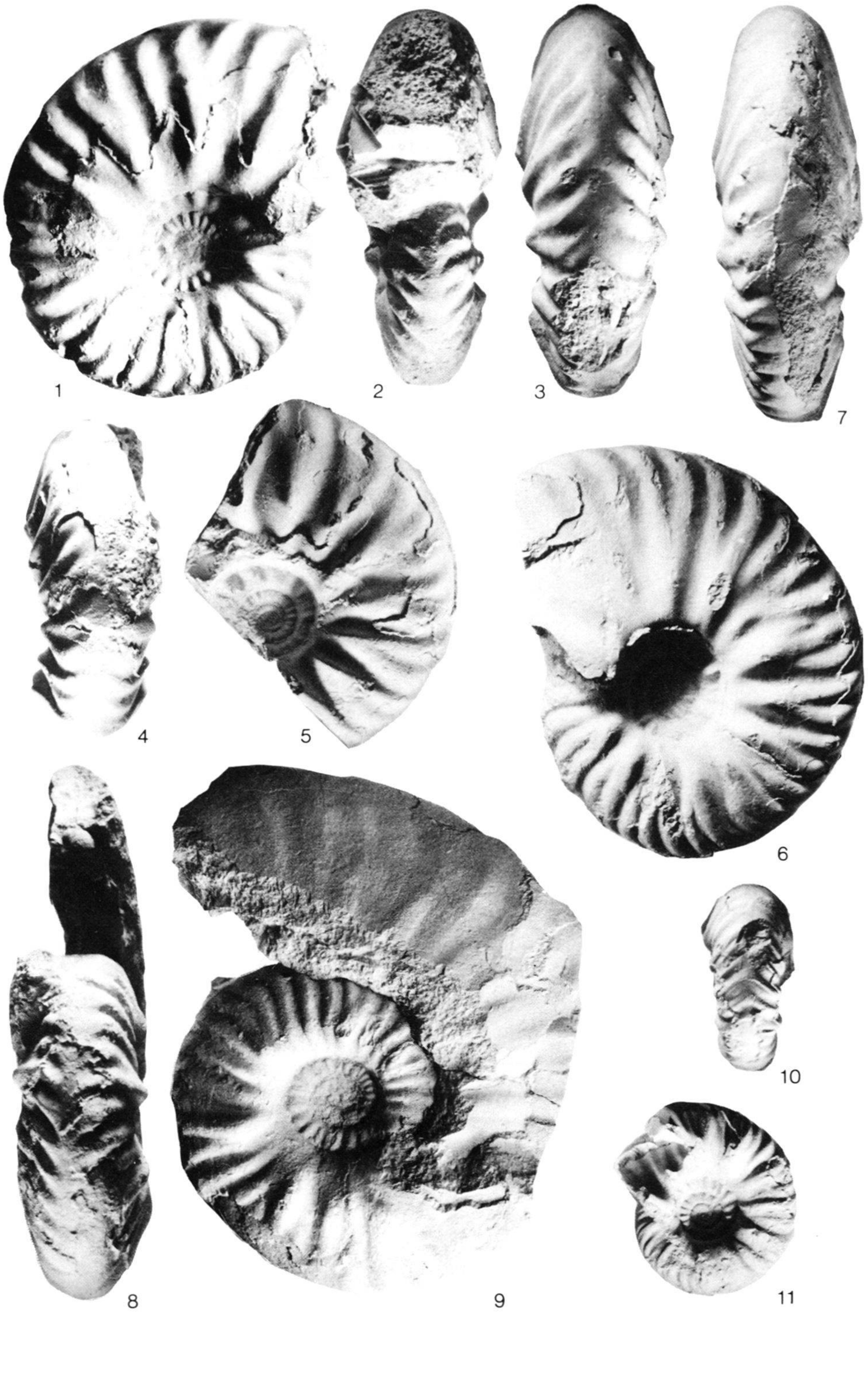
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Plate 4

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Fig. 1–16 *Eogymnotoceras thompsoni* n. gen. n. sp. Escheri Beds, *Taylori* Zone. 1–3: plesiotype, USNM 427254, loc. HB 163, Favret Canyon, Augusta Mnts. 4–6: holotype, USNM 427255, loc. HB 173, Favret Canyon, Augusta Mnts. 7–8: plesiotype, USNM 427256, loc. HB 175, Favret Canyon, Augusta Mnts. 9–10: plesiotype, USNM 427257, loc. HB 163, Favret Canyon, Augusta Mnts. 11–13: syntype, USNM 427258, loc. HB 173, Favret Canyon, Augusta Mnts. 14–16: plesiotype, USNM 427259, loc. HB 175, Favret Canyon, Augusta Mnts.

Fig. 17–18 *Anagymnotoceras* sp. A. *Anagymnotoceras* cf. *A. spivaki* Beds, *Taylori* Zone. USNM 427261, loc. HB 179, Favret Canyon, Augusta Mnts.

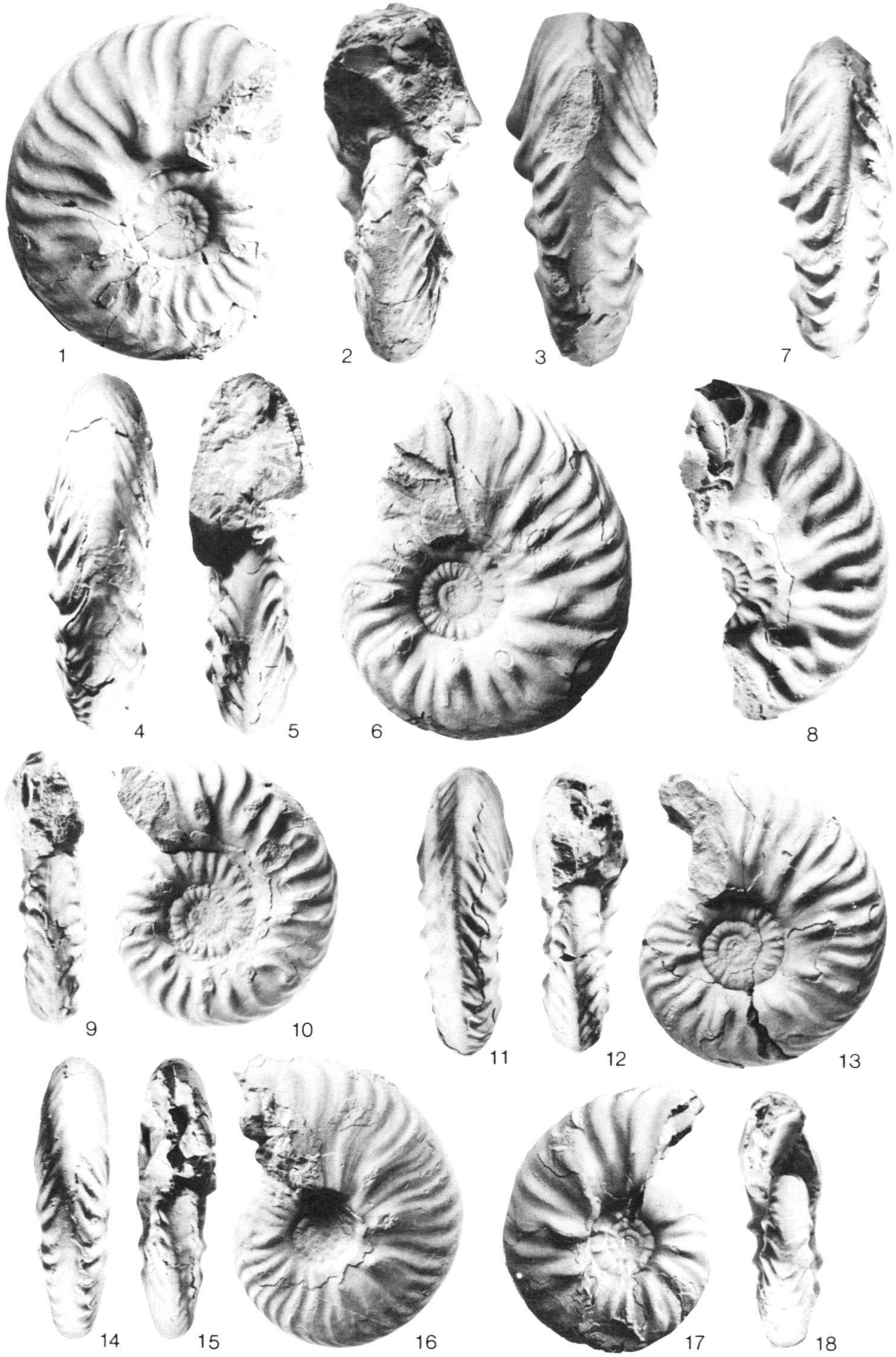
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Plate 5

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Fig. 1–3 *Nevadisculites smithi* n. gen. n. sp. Middle *Shoshonensis* Zone. Holotype, USNM 427265, loc. HB 210, Favret Canyon, Augusta Mnts.

Fig. 4–9 *Eogymnotoceras transiens* n. gen. n. sp. *Praebalatonensis* Beds, *Taylori* Zone. 4–6: syntype, USNM 427262, loc. HB 162, Favret Canyon, Augusta Mnts. 7–9: syntype, USNM 427263, loc. HB 162, Favret Canyon, Augusta Mnts.

Fig. 10–11 *Eogymnotoceras thompsoni* n. gen. n. sp. Escheri Beds, *Taylori* Zone. Plesiotype, USNM 427260, loc. HB 189, Favret Canyon, Augusta Mnts.

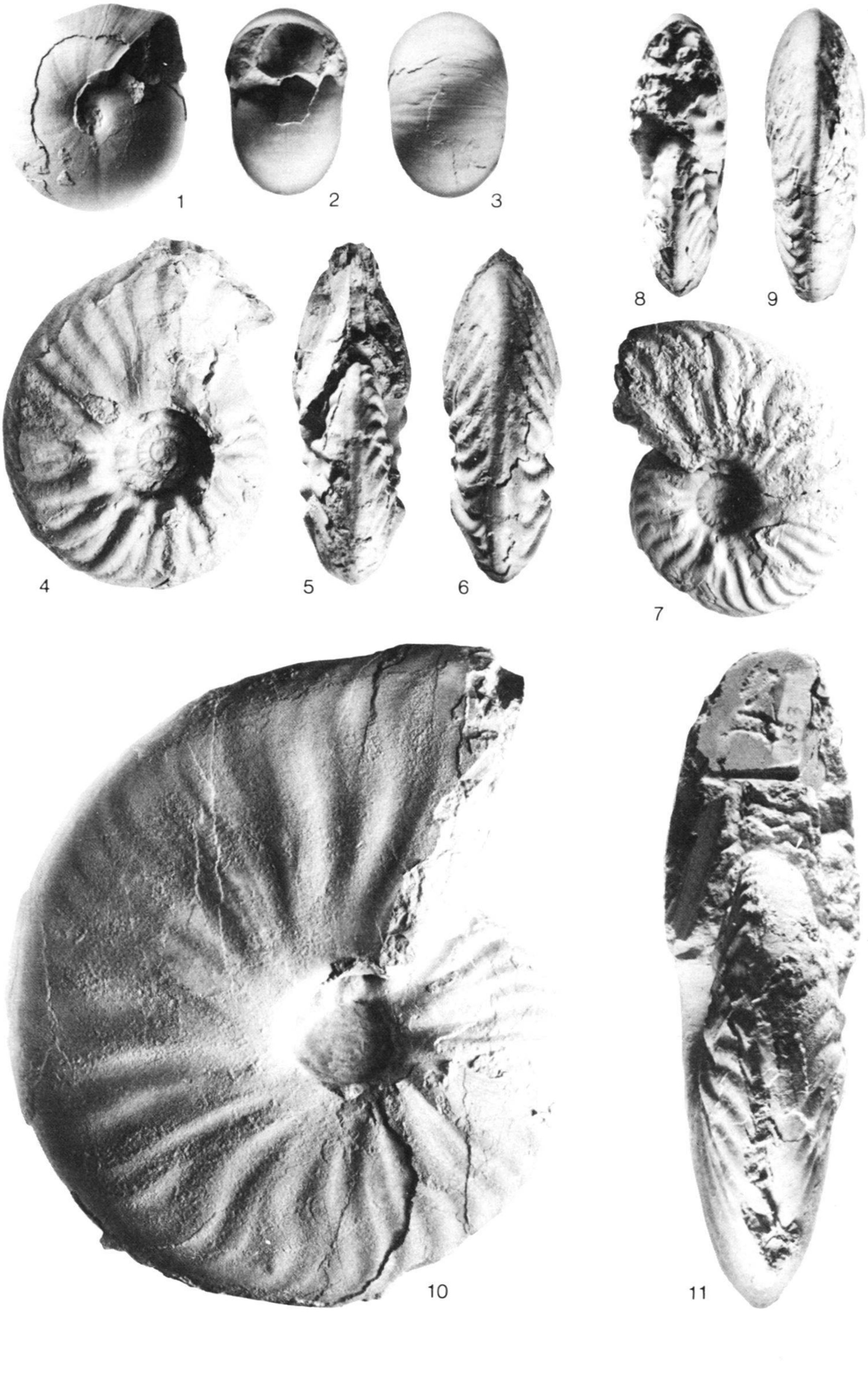
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Plate 6

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Fig. 1–2 *Pseudodanubites nicholsi* n. sp. Nicholsi Beds, *Taylori* Zone. Plesiotype, USNM 427268, loc. HB 99, Favret Canyon, Augusta Mnts.

Fig. 3–7 *Nevadisculites taylori* n. gen. n. sp. Escheri Beds, *Taylori* Zone. 3–4: plesiotype, USNM 427266, loc. HB 175, Favret Canyon, Augusta Mnts. 5–7: holotype, USNM 427267, loc. HB 216, Favret Canyon, Augusta Mnts.

Fig. 8–10 *Eogymnotoceras transiens* n. gen. n. sp. Praebalatonensis Beds, *Taylori* Zone. Holotype, USNM 427264, loc. HB 162, Favret Canyon, Augusta Mnts.

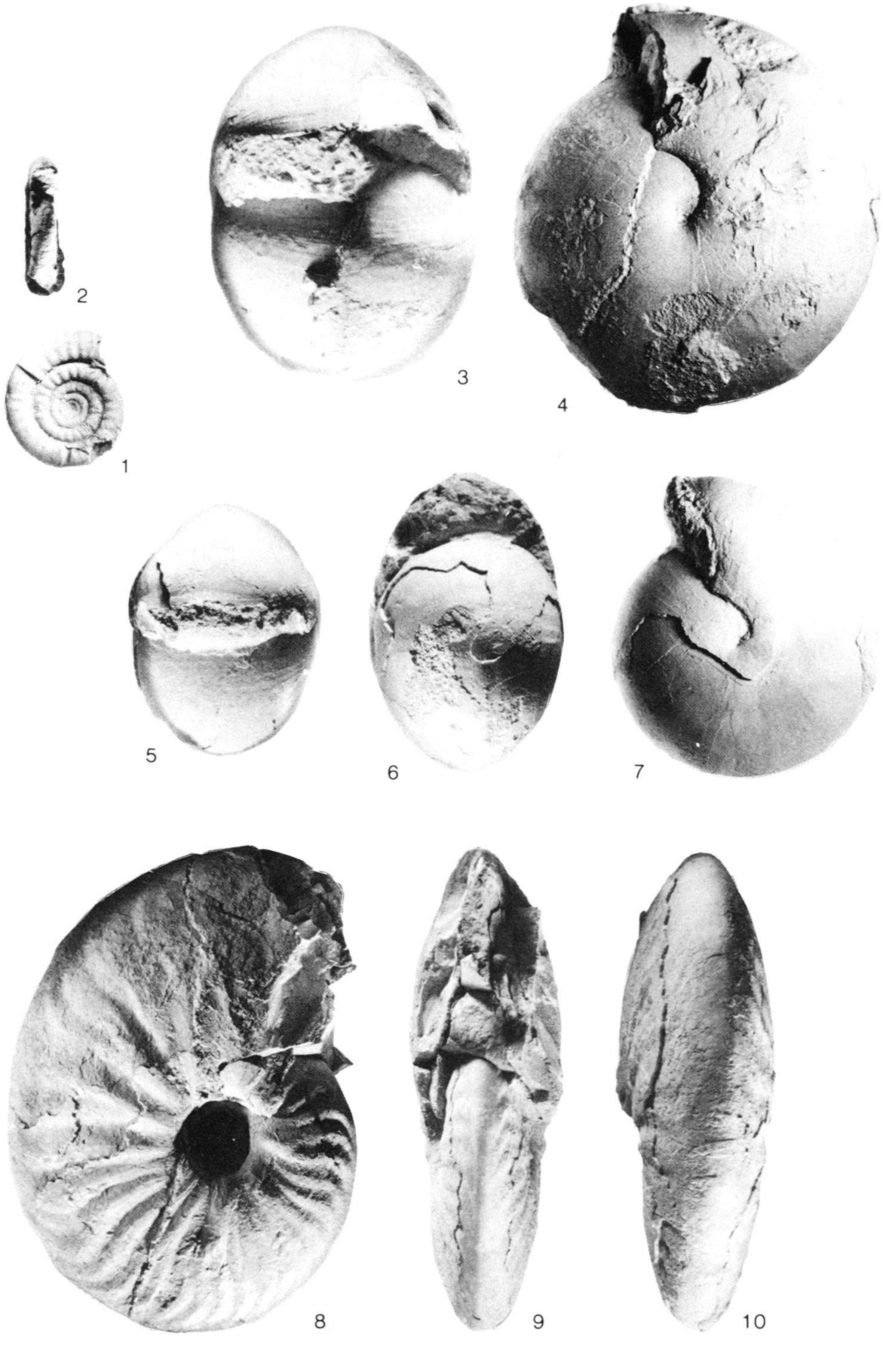
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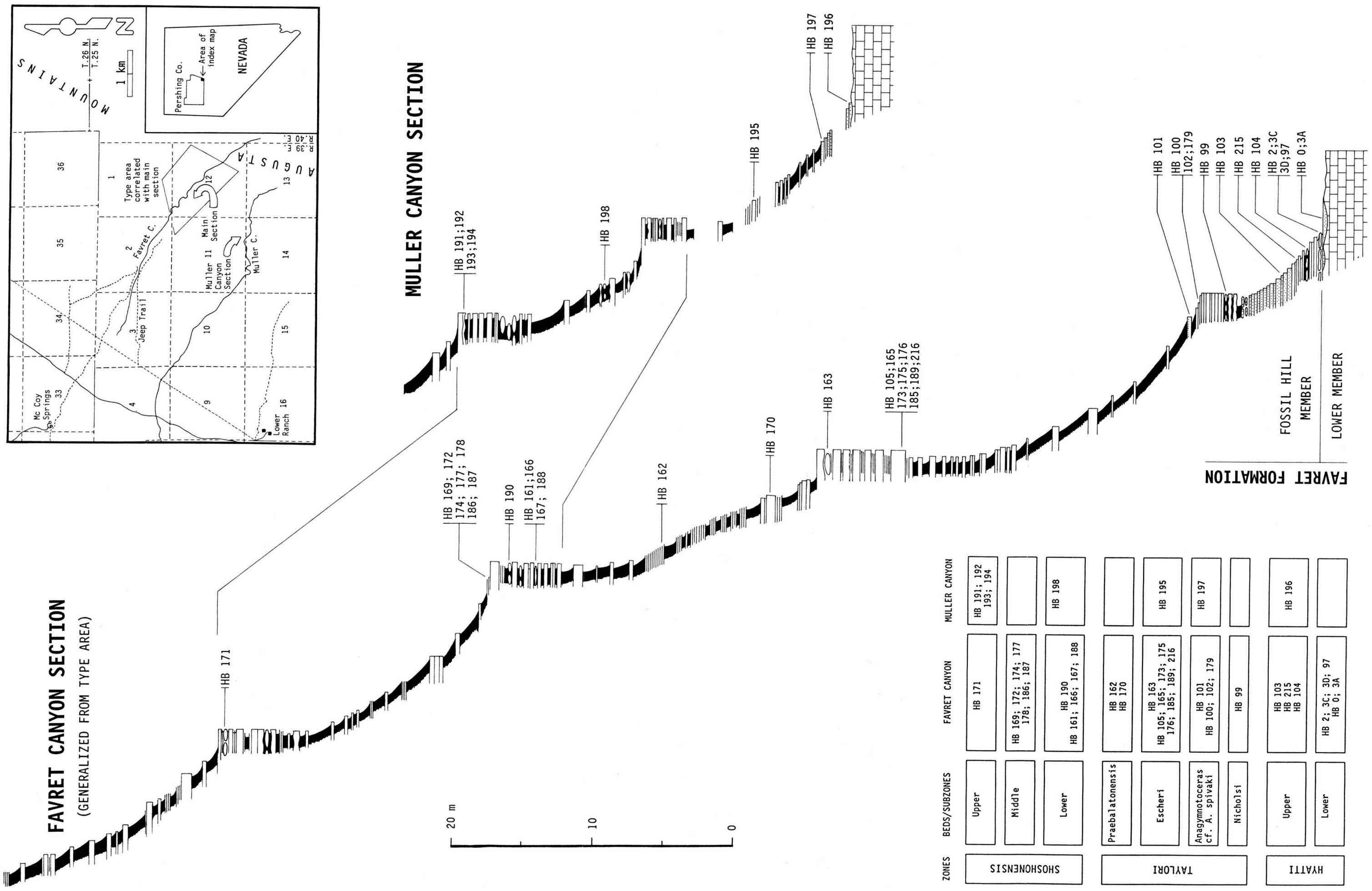
Plate 7

Favret and Muller Canyons Middle Anisian sections.



ZONES	BEDS/SUBZONES	FAVRET CANYON	MULLER CANYON
SHOSHONENSIS	Upper	HB 171	HB 191; 192 193; 194
	Middle	HB 169; 172; 174; 177 178; 186; 187	
	Lower	HB 190 HB 161; 166; 167; 188	HB 198
TAYLORI	Praebalatonensis	HB 162 HB 170	
	Escheri	HB 163 HB 105; 165; 173; 175 176; 185; 189; 216	HB 195
	Anagymnotoceras cf. A. spivaki	HB 101 HB 100; 102; 179	HB 197
	Nicholsi	HB 99	
HYATTI	Upper	HB 103 HB 215 HB 104	HB 196
	Lower	HB 2; 3C; 3D; 97 HB 0; 3A	