Lucas, S.G. and M. Morales, eds., 1993. The Nonmarine Triassic. New Mexico Museum of Natural History & Science Bulletin No. 3.

STRATIGRAPHIC AND PALEOBIOGEOGRAPHIC IMPORTANCE OF THE LATEST OLENEKIAN AND EARLY ANISIAN CONCHOSTRACANS OF MIDDLE EUROPE

HEINZ W. KOZUR[1], HORST MAHLER[2] and JÜRGEN SELL[3]

[1] Rézsü u. 83, H-1029 Budapest, HUNGARY;
[2] Lindentalstr. 29, W-8707 Veitshöchheim, GERMANY;
[3] Gerichtsgasse 3, W-8737 Euerdorf 1, GERMANY

ABSTRACT: *The biostratigraphic and paleobiogeographic importance of the latest late* Olenekian to early Bithynian (Early Anisian) conchostracan faunas of the Germanic Basin and the Mecsek Mts (southern Hungary) are discussed.

INTRODUCTION

Kozur and Seidel (1983 b) introduced 10 conchostracan zones in the Lower and Middle Buntsandstein of the Germanic Basin for a time interval from the Late Changxingian up to middle Late Olenekian. It was demonstrated that the continental Lower Triassic, comprising about 90 % of the known Lower Triassic sequences in the world, can be subdivided biostratigraphically as in detailed a fashion as ammonoid- and conodont-bearing beds.

In the Solling Formation of late late Olenekian and in the Röt Formation mostly of early early Anisian (Aegean - early Bithynian) age, however, only few horizons with conchostracans have been found. In the eastern and central Germanic Basin marine and hypersaline beds prevail during this time-interval. This facies is unsuitable for conchostracans. In the western and southwestern Germanic Basin predominantly continental beds are present in this time interval, but they consists often of inland- or coastal sabkha and sandy fluviatile beds, likewise unsuitable for conchostracans. However, in this area also deltaic plains and some temporary freshwater ponds were present in which conchostracans found suitable ecological conditions. For this reason, conchostracans are common in certain intervals, especially in the lower Grès à *Voltzia* (lower *Voltzia* Sandstone) of the Lorraine, eastern France (Reible, 1962, Gall, 1971). This fauna is clearly dominated by *Euestheria albertii albertii* (Voltz) that was often erroneously determined as *"Isaura" minuta* (von Zieten).

In the Mecsek Mountains of southern Hungary, Aegean-lower Bithynian conchostracans are, in contrast to the Germanic Basin, very common and have been described by Nagy (1959, 1960, 1969) from the Patacs Siltstone Formation. The systematic part will be published in a separate paper. To avoid the use of nomina nuda, new species are used in open nomenclature.

Geologic Setting

Most of the studied material from the Germanic Basin has been derived from Frankonia (northern Bavaria) north of Würzburg (Fig. 1). The stratigraphic sequence of the Upper Buntsandstein (Solling Fm. and Röt Fm.) of Frankonia is shown in Table 1. Asterisks mark the presence of conchostracans (* = rare, ** = common). The lower *Voltzia* Sandstone (Grès à meules) corresponds to the *Myophoria* Beds of Frankonia and Thuringia. The position of the Olenekian-Anisian and Aegean-Bithynian boundaries in the Germanic Basin is discussed in Kozur (this volume).

The about 100 m thick Patacs Siltstone Mbr. of the Mecsek Mts. (southern Hungary) consists of reddish-brown and greenish-gray silt-, clay- and sandstones, and in the upper part also dolomitic marls and dolomites. There are freshwater lake deposits, fluviatile sediments and in the upper part brackish to brachyhaline marine intercalations. Conchostracans are very common throughout the whole sequence, above all in the greenish gray claystones and siltstones. In the upper half of the formation *Costatoria costata* (Zenker) is present in some beds. Most specimens displays 14-17 extra-areal ribs as in the Early Anisian *C. costata-M. vulgaris* dolomite of Thuringia and equivalent beds in the eastern Germanic Basin and in Frankonia (Table 1; Kozur, 1974 a, b, Mahler and Sell, 1993).

For a long time, the Patacs Siltstone Fm. has been regarded as Early Scythian Seisian Beds. The base for this determination were small *Claraia clarai* (Buch) reported by Peters (1862). However, this bivalve is not present in the Patacs Siltstone Fm. Most probably conchostracans have been misinterpreted as small *C. clarai*. On the base of sporomorphs and *C. costata*, Barabas-Stuhl (1981) placed the Patacs Siltstone Fm. into the Late Scythian. However, *Costatoria* with more the 13 extra-areal ribs occur exclusively in the Anisian (Kozur, 1987) and also the sporomorph association, dominated by *Triadispora* and with *Hexasaccites thiergartii* (Mädler) Kozur is early Anisian and not late Scythian in age. On the base of the conchostracan fauna Kozur and Seidel (1983 a, b) placed the Patacs Siltstone Fm. for the first time into the early Anisian, which is today generally accepted.

Biostratigraphic Evaluation

Between the rich conchostracan faunas of the middle Late olenekian Hardegsen Formation and of the *Voltzia* Sandstone Fm. (middle early Anisian) only very few conchostracans have been known. Only Reible (1962) reported *"Isaura" minuta* (von Zieten) from the Upper Röt Claystone of Frankonia and Kozur and Seidel (1983 a, b) found *Palaeolimnadia alsatica alsatica* (Reible) in the Solling

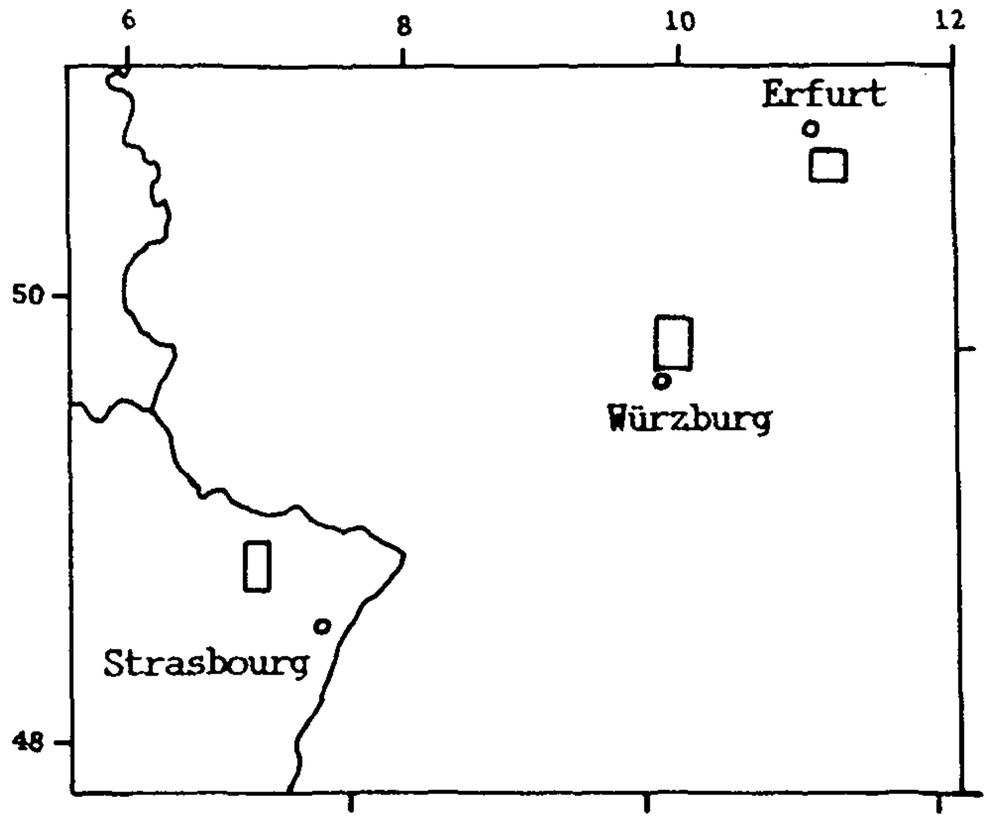


FIGURE 1. Investigated areas (rectangles). Germany: Thuringia S and SE of Erfurt (Solling Fm. of the localities Singen and Bad Berka), Frankonia N of Würzburg (Solling Fm. and Röt Fm. of the (localities Hammelburg, Aura, Wiesenfeld, Hirschberg E Erlabrunn, Kerntalgraben NW Erlabrunn). France: Lorraine (lower *Voltzia* Sandstone Fm. of Arzviller, Bust, Vilsberg).

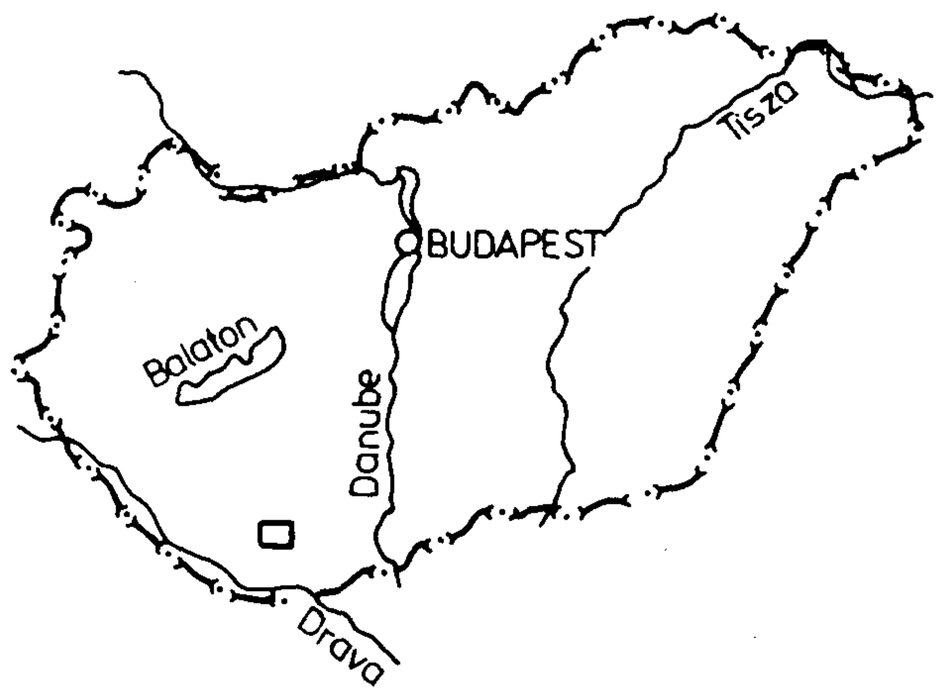


FIGURE 2. Investigated area (rectangle) in southern Hungary (Mecsek Mts, Patacs Siltstone Mbr. of Patacs W of Pecs and from boreholes).

Fm. of Thuringia. Re-investigations of Reible's material by the authors and the study of new material from the upper part of the Upper Röt Claystone have shown that Reible's "*Isaura" minuta* from this stratigraphic level are primitive small *Euestheria albertii albertii* with L max. around 4 mm (compared to 5 mm in the lower *Voltzia* Sandstone Fm. and in the *Myophoria* Beds).

The direct forerunner of the nominate subspecies, *E. albertii* n. subsp. A, was now found in the Solling Fm. It is smaller (L max. = 3.2 mm) and more slender (L/H = 1.41-1.45 against 1.2-1.33 in *E. albertii albertii*). Additionally, the very slender *Euestheria* n. sp. B has been found in the Solling Fm., whereas *E. exsecta* is more present in the Solling Fm. Now the conchostracan fauna of the Solling Fm. can be well separated from the conchostracan faunas both of the Hardegsen Fm. and of the upper part of the Upper Röt Claystones (Tab. 2).

In the Rötquartzite only poorly preserved conchostracans are present. They belong to the *E. albertii* group, but *E. albertii albertii* is not present. Regarding the fact that *E. albertii albertii* from the upper part of the Upper Röt Claystone consists only of primitive, relatively small forms (L max. around 4 mm), we assume that *E. albertii albertii* begins in this level. The base of the *E. albertii albertii* Zone coincides therefore with the base of the *Beneckeia buchi-Myophoria vulgaris-Dadocrinus* A.Z. defined by Kozur (1974 a, b, 1975), who placed this zone in the early Anisian. The base of this zone is marked in the largest part of the Germanic Basin by a horizon with joint occurrence of *Costatoria costata* s.str. with *Myophoria vulgaris* (Kozur, 1974 a, b, Mahler and Sell, 1993). It is regarded as the base of the Bithynian (Kozur, this volume).

The *E. albertii albertii* Zone, introduced here and defined by the range of *E. albertii albertii*, is therefore regarded as Bithynian. Within this zone, a finer subdivision can be made by the phylomorphogenetic increase of size of *E. albertii albertii* from L max. = 4 mm to L max. = 6.3 mm. In the *Myophoria* Beds (Lower and Upper Dendritic Beds) of Frankonia, L max. of *E. albertii albertii* is 5 mm. Exactly the same value can be observed in the lower *Voltzia* Sandstone Fm. of the Lorraine. This confirms the correlation of the Lower *Voltzia* Sandstone Fm. with the *Myophoria* Beds (Upper Röt) of the central Germanic Basin by Kozur (1974 a, b, 1975). The still larger *E. albertii albertii* of the Holbrook Member (Moenkopi Formation) of Arizona (L max. = 6-6.3 mm) can be therefore placed in the upper *E. albertii albertii* Zone (upper Bithynian).

In contrast to former data (Nagy, 1959, 1960), *E. albertii albertii* is missing in large parts of the about 100 m thick Patacs Siltstone Fm. of southern Hungary. Only in the upper 20 m of the type locality of this formation, *E. albertii albertii* is present; large advanced specimens occur in the uppermost part of this formation. Therefore, the upper 20 m of the Patacs Siltstone Fm. in its type locality can be correlated with the Bithynian; the lower and middle part of the formation belongs to the Aegean.

Paleobiogeographic Evaluation

Conchostracans have drought-resistant eggs that can be transported by wind over huge areas. Conchostracans can only live in freshwater ponds and lakes and in brackish (up to mesohaline brackish) estuarine environments. The distribution of conchostracan species in these environments is climate-controlled. In the latest Olenekian to early Bithynian time two distinct dry climatic girdles were present, a northern dry girdle, to which belongs the Germanic Basin, and a southern dry girdle, to which belong the Arabic countries, Israel and Arizona. In all these areas a semiarid climate prevailed. Continental and marine hypersaline (gypsum, partly halite) deposits are common, but also fluviatile deposits and deposits from temporary freshwater lakes or ponds occur. The conchostracan faunas and successions in all these areas are similar. In the Germanic Basin, in the Arabic countries and Israel the same situation can be found in the Carnian, where again hypersaline deposits are dominant in the early and late Carnian. Arizona,

St.	Ss	Lithostratigraphy		
	B	0.7 m "Grenzgelbkalk" (basal Lower Wellenkalk of the Lower Muschelkalk)		
	I	50 cm "Strohgelbe Kalke": Yellowish dolomitic marls, basal silty, micaceous. Plant remains, *Lingula*, insects.**	*M*	R
	T		*y*	
		3 m "Upper Dendritic Beds": Gray clay-, silt- and sandstones. Only few	*o*	
A	H	yellow beds. Plant remains.**	*p*	ö
	Y	6.5 m "Red Intercalation": Reddish brown clay-, silt-, very thin sand= stones; distinct violet soil horizons with dolomite nodules.	*h.*	t
N	N		B	
		2.2 m "Lower Dendritic Beds" ("*Myophoria* Plates"): Yellowish green or	e	
	I	gray, in the upper part also reddish clay-, silt- and sandstones.**	d	
			s	
I	A	9-11 m "Upper Röt Claystones", upper part: Reddish crumbly shales with		F
	N	4 marine to brackish horizons of greenish, fine-sandy siltstones with *Myophoria vulgaris*, basal marine horizon brownish with *Costatoria costata* and *M. vulgaris*.** Above all immediately below the marine horizons several		o
S		violet soil horizons with dolomite nodules.		r
		15 m "Upper Röt Claystones", lower part: Reddish-brown clay- and siltstones (mostly crumbly shales), anhydrite nodules.		
I	A			m
		7-11 m "Röt Quartzite" ("Frankonian *Chirotherium* Sandstone"): Light-gray,		
	E	reddish, greenish quartzites with soil horizons (carneol-dolomite horizons).		
		Chirotherium tracks and worm traces.*		a
A	G			
		"Lower Röt Claystone": Reddish brown to violet clay- and siltstones, often		
	E	crumbly shales, soil horizons with dolomite nodules. Few sandstones with		t
		ribble marks, halite pseudomorphs. Some gypsum.		
N	A			
		0.2-0.5 "Boundary Quartzite": Whitish-green quartzites above green clays.		i
	N			
		29-50 m "Platy Sandstone": Reddish to pale violet bedded sandstones (banks up to 2 m thick, separated by greenish-gray and red claystones. Halite		
		pseudomorphs. Conifers, "*Mastodonsaurus*" *ingens*.		o
O		2.5-4 m "*Chirotherium* Shales": Greenish gray silt-, clay- and sandstones		n
L		with halite pseudomorphs. Plant remains, *Chirotherium* tracks.*		
E				
N	L	4 m "Solling Sandstone" with halite pseudomorphs, vertebrate tracks;*	Sol=	
E	A	upper 2 m whitish-greenish sandstones with black manganese oxide spots;		
K	T	lower 2 m reddish sand-, silt- and claystones.	ling	
I	E			
A		0.7-0.8 m Soil horizon with carneol-dolomite nodules.	Fm.	
N				
		H-disconformity		

Abbreviations: St. = Stage
Ss = Substage

TABLE 1. Stratigraphic subdivisions of the Solling Fm. and Rot Fm. of Frankonia.

unit	a	b	c	d	e	f	g	h	i	j	k	l	m	n
"Strohgelbe Kalke"				+					?		?			*
Upper Dendritic Beds				+				+						
Lower Dendritic Beds				+				*	+	+	*			
Lower Voltzia Sdst. Fm.				+				*	+	+	*	+	+	
Upper Röt Claystones				+			+	*						
Röt Quartzite					?									
Solling Fm.				+	+	+								
Hardegsen Fm.	*	*	+											

TABLE 2. Distribution of the middle Late Olenekian to Bithynian conchostracans of Frankonia and the Lorraine * = common + = rare ? = determination questionable a = *Euestheria exsecta* (Novozhilov), b = *Palaeolimnadia* ? *nodosa* (Novozhilov), c = *P. alsatica detfurthensis* Kozur and Seidel, d = *P. alsatica alsatica* Reible, e = *Euestheria albertii* n. subsp. A, f = *Euestheria* n. sp. B, g = *Euestheria* n. sp. C, h = *Euestheria albertii albertii* (Voltz), i = *Euestheria* n. sp. D (= *Isaura* sp. B Gall, 1971), j = *Liograpta* (*Magniestheria*) ? n. sp. A (= Isaura sp. A Gall, 1971), k = *Liograpta* (*Magniestheria*) n. sp. B , l = *Lioleaiina* n. sp. (= *Praeleaia* sp. Gall, 1971), m = *Dictyonatella dictyonata* (Reible), n=*Palaeolimnadia* n. sp. A

in contrast, shifted into the humid equatorial zone. Carnian hypersaline deposits are there missing. The Carnian conchostracan faunas of the Germanic Basin are characterized by the coarsely reticulated genus *Laxitextella* Kozur. The Carnian conchostracans of the southern dry girdle are poorly known, but *Laxitextella* is present. In the USA conchostracans are common in the Carnian, but *Laxitextella* is missing.

The Aegean to lower Bithynian Patacs Siltstone Fm. consists of fresh-water and brackish deposits, in the upper part some brachyhaline marine deposits are present. Hypersaline deposits are missing, in contrast to the Germanic Basin. This intra-Tethyan area was seemingly situated within the equatorial humid girdle. Also in the Carnian, hypersaline deposits are totally missing and only freshwater and slightly brackish deposits occur. Only in the Magyarürög Anhydrite Member above the Patacs Siltstone Fm. hypersaline deposits are common. These upper Bithynian deposits correspond to parts of the Lower Wellenkalk of the Germanic Basin. In this time interval in the Germanic Basin no hypersaline deposits are known (marine deposits with normal salinity, in northern marginal area reddish and gray brackish marls).

The Aegean-lower Bithynian conchostracan fauna of the Patacs Siltstone Fm. is very different from the conchostracan faunas of the Röt Fm. *Palaeolimnadia mecsekensis* clearly dominates. This species is absent in the Germanic Basin, where 2 other *Palaeolimnadia* species are present that are not related to *P. mecsekensis*. The second common form is *Euestheria* ? n. sp. E, in which the posterior margin is higher than the anterior one. This species is also unknown from the Germanic Basin and does not belong to the *E. albertii* group that dominates all latest Olenekian to Bithynian conchostracan faunas of the Germanic Basin. *E. albertii albertii* is present only in the upper 20 m of the Patacs Siltstone Fm. and in the overlying Magyarürög Anhydrite Mbr. This invasion of the *E. albertii* group is clearly related to an aridification of the climate indicated by predominantly hypersaline deposits in the Magyarürög Anhydrite Mbr. The Carnian conchostracan faunas of the Mecsek Mts are also totally different from those of the Germanic Basin. The fauna is, in contrast, similar to North American conchostracan faunas.

ACKNOWLEDGMENTS

We thank very much Dr. G. Geyer, Würzburg for the possibility to study the collection Reible and for photos this material. The investigations by H. Kozur have been sponsored by the Deutsche Forschungsgemeinschaft, project 1224/3-1. He is very thankful for this support.

REFERENCES

Barabás-Stuhl, A., 1981, Microflora of the Permian and Lower Triassic sediments of the Mecsek Mountains (south Hungary): Acta Geologica Academiae Scientiarum Hungaricae, v. 24 no. 1, p. 49-97.

Gall, J.-C.,1971, Faunes et paysages du Grès á *Voltzia* du Nord des Vosges. Essai paléoécologique sur le Buntsandstein supérieur: Mémoires du Service de la Carte géologique d'Alsace et de Lorraine, v. 34, 318 pp.

Kozur, H.,1974 a, Biostratigraphie der germanischen Mitteltrias. Teil I: Freiberger Forschungshefte, v. C 280, p. 1-56.

--1974 b, Biostratigraphie der germanischen Mitteltrias. Teil II: Freiberger Forschungshefte, v. C 280, p. 1-70.

--1975, Probleme der Triasgliederung und Parallelisierung der germanischen und tethyalen Trias. Teil II: Anschluß der germanischen Trias an die internationale Triasgliederung: Freiberger Forschungshefte, v. C 304, p. 51-77.

--1987, Stratigraphisch wichtige Fossilfunde in der Werfen-Gruppe des Balaton-Hochlandes (vorläufige Mitteilung): Geologisch-Paläontologische Mitteilungen Innsbruck, v. 14 no. 7, p. 157-167.

Kozur, H., and Seidel, G., 1983 a, Revision der Conchostracen-Faunen des unteren und mittleren Buntsandsteins. Teil I: Zeitschrift für geologische Wissenschaften, v.11, no. 3, p. 289-417.

--1983 b, Die Biostratigraphie des unteren und mittleren Buntsandsteins unter besonderer Berücksichtigung der Conchostracen: Zeitschrift für geologische Wissenschaften, v.11, no. 4, p. 429-464.

Mahler, H., and Sell, J (1993): Die "*vulgaris/costata*-Bank" (Oberer Buntsandstein, Mitteltrias) - ein lithostratigraphisch verwertbarer biostratigraphischer Leithorizont mit chronostratigraphischer Bedeutung.- In Hagdorn, H. and Seilacher, A. (eds.): Muschelkalk. Schöntaler Symposium 1991.- Sb. Ges. Naturk. Württemberg, 2, 187-192, 3 figs., Stuttgart.

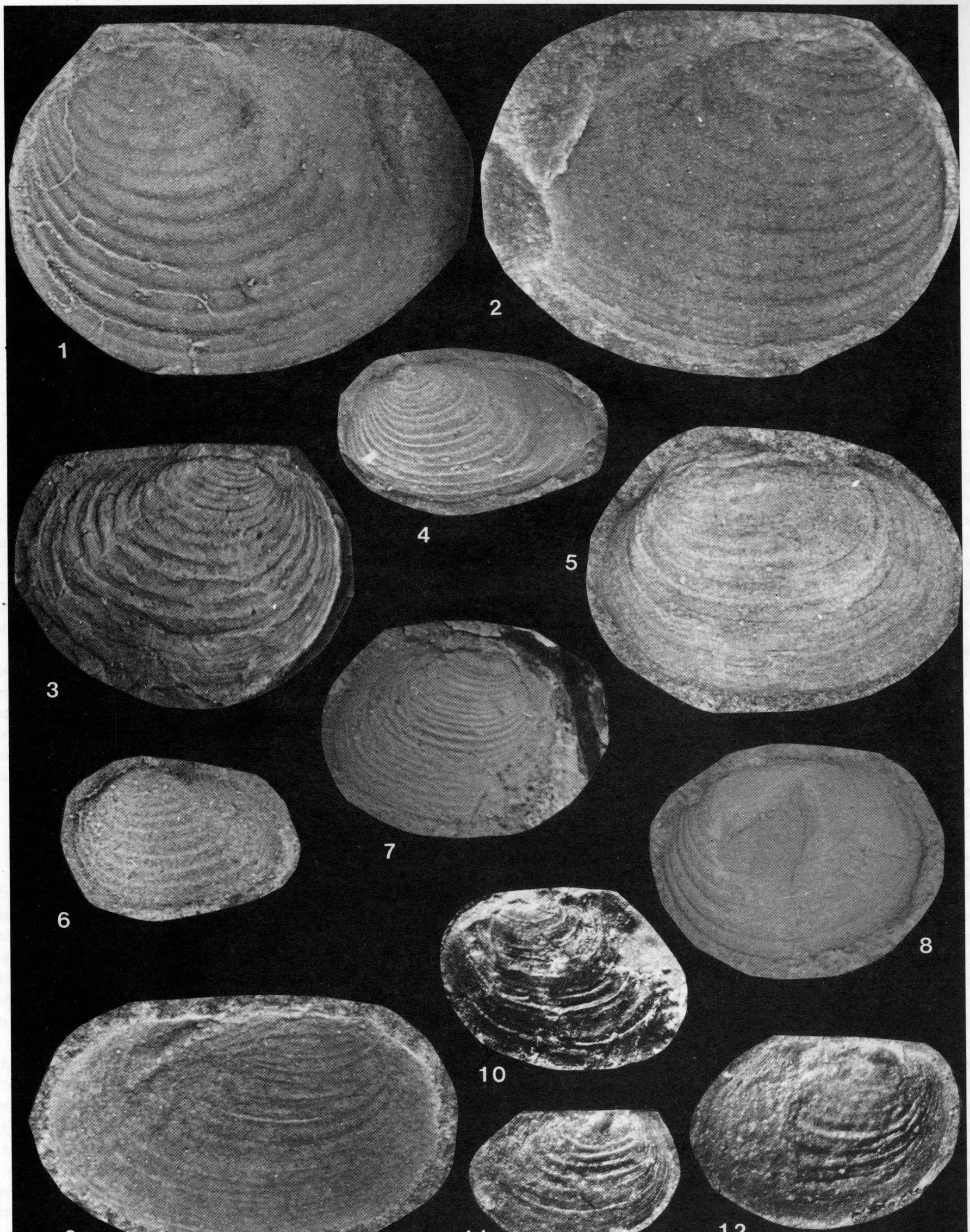
Nagy, E., 1959), A Mecsek-hegység alsóverferni képzödményeinek faunája: Földtani Közlöny, v. 89, no. 3, p. 317-320.

--1960, A Mecsek-hegység mezozóos Phyllopodái: Földtani Közlöny, v. 90, no. 1, p. 137-142.

Peters, K., 1862, Über den Lias von Fünfkirchen: Sitzungsberichte der Akademie der Wissenschaften, Wien, mathemathisch-naturwissenschaftliche Klasse, v. 46, p. 1-53.

Reible, R.,1962, Die Conchostraken (Branchiopoda, Crustacea) der germanischen Trias: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 114, p. 169-244.

FIGURE 3. All specimens X15 1-3, *Euestheria albertii albertii* (Voltz), 1, 2, SMTE 5825/2-184a, b, Lower Dendritic Beds, Röt Fm., early Bithynian, Hammelburg; 3, primitive form, SMTE 6024/5-17a, Upper Röt Claystone, basal Bithynian, Wiesenfeld. 4, *Euestheria* n. sp. B, SMTE 5826/13-16 a, Solling Fm., latest Olenekian, Aura. 5, 9, *Liograpta* (*Magniestheria*) n. sp. B, 6, SMTE 5825/2-189, 9, SMTE 5825/2-26, Lower Dendritic Beds, Röt Fm., Hammelburg. 6, *Euestheria albertii* n. subsp. A, SMTE 5826/13-18, Solling Fm., latest Olenekian, Aura. 7, *Euestheria* n. sp. C, P 57, Upper Röt Claystone, basal Bithynian, Hirschberg E Erlabrunn (= *Isaura minuta minuta* from the collection Reible). 8, *Palaeolimnadia* n. sp. A, SMTE 5825/2-195, "Strohgelbe Kalke", uppermost Röt Fm., early Bithynian, Hammelburg. 10, *Euestheria* ? n. sp. E, KMS I/5, Patacs Siltstone Fm. of the type locality, sample B, 26.5 m below the top of the formation, early Bithynian. 11, 12, *Palaeolimnadia mecsekensis* Nagy, Patacs Siltstone Fm. of the type locality, 11, KMS I/36, sample E, 99.3 m below the top of the formation, Aegean; 12, KMS I/15, sample D, 45.4 m below the top of the formation, early Bithynian.


1
2
3
4
5
6
7
8
9
10
11
12