

LATE DEVONIAN INDEX BRACHIOPODA OF NORTH-EAST ESFAHAN IN CORRELATION WITH OTHER REGIONS

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Abstract

Abundance and multilateral extension of prominent genus and species of Brachiopoda in the majority of sedimentation series of the Late Devonian have been observed in all parts of Iran. The variability and rapid change in this respect has made it possible to delineate different lines of orthogenetism, biozonation and present biostratigraphical models at the sub-stage level. These characteristics have prompted this study on the external character, biometry and internal properties of specimens to provide a taxonomy and comparison of genus, species and subspecies of the Late Devonian Brachiopoda in different parts of Iran, especially in north of Esfahan, Abadeh region, north of Kerman, south-east of Anarak, Shotori Range, Central Alborz, Damghan, and Shahrud regions. In the orders Spiriferida, Rhynchonellida, Strophomenida, and Orthida, many genera and species can be identified and their stratigraphical expansion and geographical situation can be compared. The study has involved ten genera and species of Rhynchonellida, ninety genera and species of Spiriferida, twelve species and subspecies of Strophomenida, and two genera of Orthida.

Introduction

For Biocorrelation of Late Devonian in different parts of Iran, such as central and western Alborz, north of Esfahan, southeast of Anarak, Kerman and Abadeh, manuscripts and studies about Late Devonian sequences were reviewed as research projects and M. Sc. theses. This paper briefly discusses these studies. Morphologic and internal structures of index brachiopods and new taxons are examined separately.

Keywords: Devonian; Frasnian; Famennian; Biostratigraphy; Brachiopoda

Due to the stratigraphical situation and environmental sedimentation of Devonian rocks, and the variety of

species and index genus of Brachiopods, it is tried to find an acceptable Devonian type section that involves a complete series of Devonian sediments. For this purpose, biometric examinations of Brachiopoda were made in Kuh-e-doshakh and north of Esfahan.

Description

Late Devonian sediments are exposed in two areas at northeast of Esfahan. In 60-Km northeast of Esfahan, at Zefreh area, Late Devonian sediments range from Middle to Late Frasnian. There is no evidence of Famennian and Carboniferous in this area. After lateritic bed, a sequence of light quartzitic sandstone and light yellowish dolomite overlies the Devonian rocks. These

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sediments can be considered to be Permian (in base) and Middle Triassic times, based on lithocorrelation. This laterite can be suggested as a trace of erosion and epirogenic movement in Carboniferous time-interval. This erosion evidence is also reported from some parts of Iran at equivalent times. Another outcrop of Devonian sequences can be seen in 10 Km west of Zefreh, at Chah-Riceh area. The first research in this area, based on brachiopods, was performed by Jafarian

& Brice in 1973 [20]. According to this study, the Devonian sediments range from Middle Frasnian into Late Famennian and Strunian times. After that, there is a paleosol or red shales, which is disconformably covered by Late Permian deposits [25]. In this section, Carboniferous and Early Permian sediments are absent. Stratigraphic position of Late Devonian sequences in Chah-Riceh and Zefreh are approved by palinologic [32] and conodont studies [14,21] (Tables 1, 2, 3).

Table 1. Repartition of Frasnian index fossils [13,17,21,28,30]

	Chah-Riceh	Anarak	Kerman	Alborz	Tabas
<i>Uchtospirifer multiplicatus</i>	*	*			
<i>Cyphoterorhynchus koraghensis</i>	*	*	*		*
<i>C. koraghensis interpositus</i>	*				*
<i>C. arpaensis</i>		*	*	*	*
<i>Cyrtospirifer schelonius</i>	*	*	*		
<i>Athyris chitralensis</i>	*	*	*	*	*
<i>Atrypa reticularis</i>		*	*		*
<i>Ripidiorhynchus elburzensis</i>	*	*	*	*	
<i>Spinatrypina chitralensis</i>	*	*	*		*
<i>Spinatrypa bifidaeformis</i>		*	*		
<i>Spinatrypina robusta</i>		*	*		
<i>Spinatrypina gr. bodini</i>	*				
<i>Coeloterorhynchus tabasensis</i>		*			*
<i>Cyrtospirifer verneuli</i>	*	*	*		
<i>Disphyllum godfussi</i>		*	*		*
<i>Hexagonaria hexagonom</i>	*	*	*		
<i>Crurithyris inflata</i>	*		*		
<i>Cyrtina heteroclita</i>	*		*		

Table 2. Repartition of Early and Middle Famennian index fossils [13,17,21,28,30]

	Chah-Riceh	Anarak	Kerman	Alborz	Tabas
<i>Centrorhynchus turanica</i>	*	*	*	*	*
<i>Platyspirifer paronei</i>	*		*	*	
<i>Platyspirifer minutus</i>	*		*		
<i>Cyrtiopsis graciosa</i>	*	*	*		
<i>Cyrtiopsis lapparenti</i>	*	*			
<i>Dmitrya seminoi</i>		*	*	*	
<i>Cyrtospirifer asiaticus</i>		*	*		
<i>Cyrtospirifer quadratus</i>	*	*	*		*
<i>Paugastroderhynchus nalivkini</i>	*	*		*	
<i>Mesoplica tas – adyrica</i>		*	*		
<i>Productella bitalensis</i>	*	*	*		*
<i>Productella subaculeata</i>	*	*	*		
<i>Douvillina interstitialis</i>	*	*	*		*
<i>Gastrodetoechia iranica</i>				*	

Table 3. Repartition of Late Famennian and Strunian index fossils [12,16,20,27,29]

	Chah-Richeh	Anarak	Kerman	Alborz	Tabas
<i>Masoplica praelonga</i>	*	*	*		
<i>Eobrachythyris Strunianus</i>	*	*	*		
<i>Eobrachythyris Strunianus alatus</i>	*	*	*		
<i>Eobrachythyris provalis</i>	*	*			
<i>Aulacella interlineata</i>	*	*	*		
<i>Schizophoria impressa</i>	*	*	*	*	*
<i>Toryniferella echinulata</i>	*	*	*		
<i>Cleiothyridina coloradensis</i> [15]	*	*	*		
<i>Megalopterorhynchus aff. baldwini</i>	*	*	*		
<i>Athyris concentrica</i>	*	*			*
<i>Athyris (Drovithyris) sp. nov.</i>	*	*			
<i>Gastrodetoechia dichotomian assimulata</i>	*	*			
<i>G. utahensis rugosa</i>	*		*		*
<i>Buxtonia singularis</i>		*	*		*
<i>Syringothyris carteri</i>				*	

Table 4. Repartition of index brachiopods in Iran and other regions [6,8-12,15,20,24,27,28]

	Esfahan	Kerman	Khoshyeilagh	Geirud	Afghanistan	Pamir	Kasakhestan	France	Morocco	Canada
Cyrtospirifer	*		*	*	*				*	*
Cyrtiopsis	*	*			*					
Tenticospirifer	*		*					*	*	*
Eobrachythyris	*	*			*			*		
Cleiothyridina	*	*	*		*			*		*
Athyris	*		*	*	*	*	*	*	*	*
Drovithyris	*									
Megalopterorhynchus	*				*					
Pauogasteroderhynchus	*		*	*	*		*		*	
Gastrodetoechia	*	*		*	*	*				*
Centrorhynchus	*	*	*		*	*		*		
Mesoplica	*	*			*			*		*
Marginatia	*								*	
Leptagonia	*	*	*	*			*	*		
Aulacella	*					*	*	*	*	

In the Abadeh area (Kavir 4 and Esteghlal mines), Late Devonian sediments including Late Frasnian-Famennian and Strunian, and Early Carboniferous sequences are reported.

In southeast of Esfahan, Shahreza area, a thick outcrop of Early Carboniferous is exposed in a small anticline. After a disconformity, Late Permian sediments were deposited. However, Late Carboniferous and Early Permian rocks are absent. On the other hand, in 30 Km south of last mentioned area, at Shah-Ghandab location, Early Permian sediments are completely exposed and even continued into Triassic (transition zone) [4].

In Kerman region, based on brachiopods, the Devonian strata belong to Early Frasnian, Famennian and Strunian times [27]. Also Early Carboniferous to Late Viséan strata are reported. Recent researchers revealed that Givetian and/or older sediments are present in Kerman region [26], but these evidences are not approved by brachiopods yet.

A sedimentary sequence similar to Padeha and Sibzar Formations were reported and assigned to Early and Middle Devonian in Soh area [34], but this is not proved with paleontological records. Recently, based on conodonts, microvertebrates, corals, and trilobites, Givetian time is reported in a section at Soh area [1].

In central Alborz, Devonian sequence is assigned to Late Devonian (Middle Frasnian-Famennian and Strunian) [12]. After a short gap, sedimentation was continued into Middle Visean. A hiatus can be considered in this area which encompasses Late Carboniferous and Early Permian sediments. In east of Alborz, Khosh-yeilagh area, evaporated and sandstone covering Silurian strata were previously assigned to Padeha Formation of Early Devonian time, and dolomites above that were considered as Sibzar Formation with Middle Devonian age. But brachiopods revised by the author [18] and palinologic studies made by Sabouri [30] and Ghavidel-syooki [13], revealed that these sediments are Early Frasnian, and are probably the latest series of Late Givetian times (Figs. 1, 2, 3).

Conclusion

In the different parts of Iran studied in this paper, there is no evidence of index fossil of Brachiopoda from Early to Middle Devonian time-interval. It seems that the Padeha and Sibzar Formations in east of Central Iran which have been proposed for type section as Lower and Middle Devonian, may be a part of Lower Frasnian sequences. The Chah-Riceh section, NE Esfahan is a complete section of Late Devonian (Frasnian-Famennian and Strunian). The Doshakh section in southeast of Anarak is a complete section from Frasnian to the end of Early Carboniferous. It can be considered as a reference section for Late Devonian to Early Carboniferous time-interval.

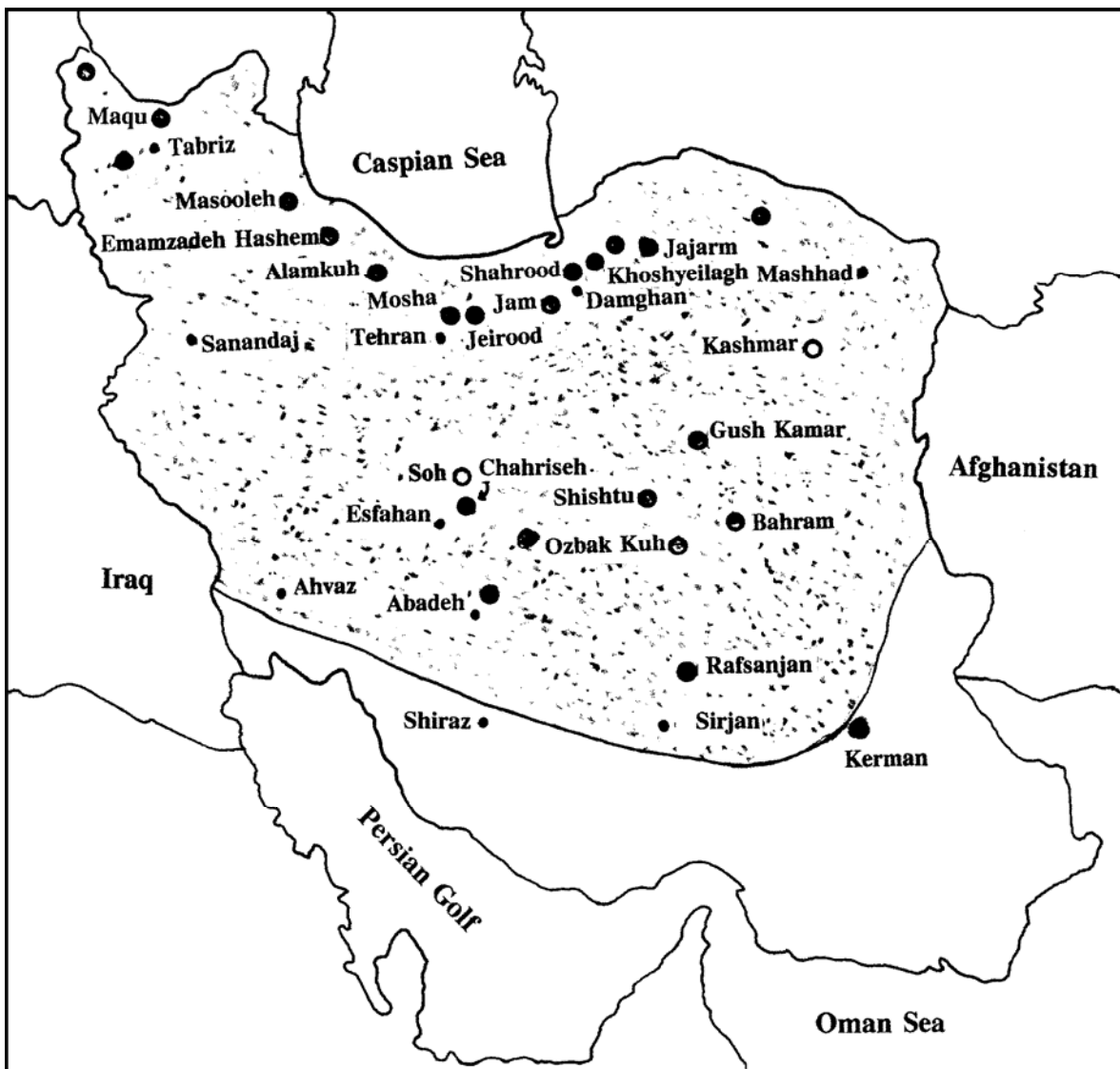


Figure 1. Paleogeography of Late Devonian (Strunian) in Iran.

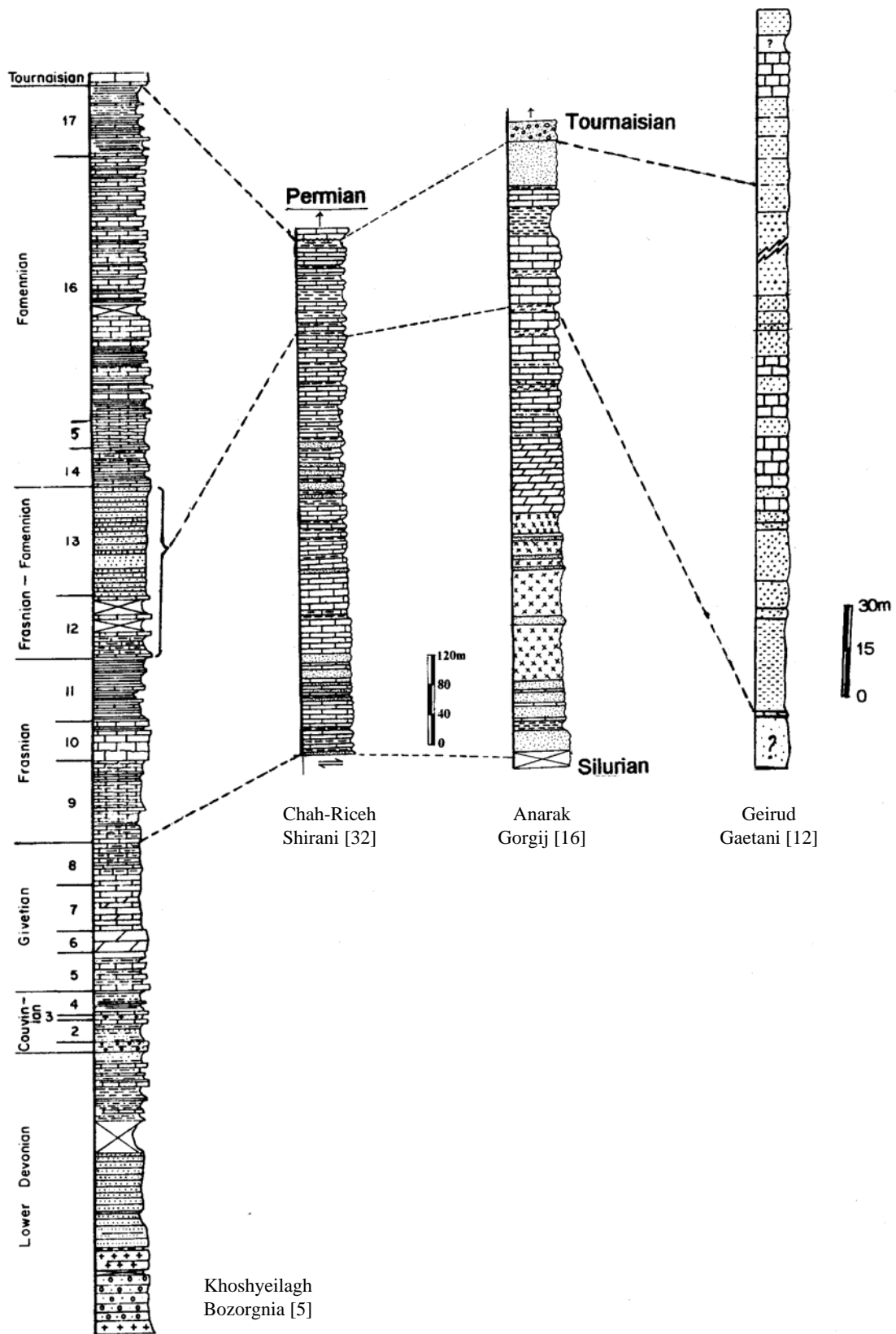
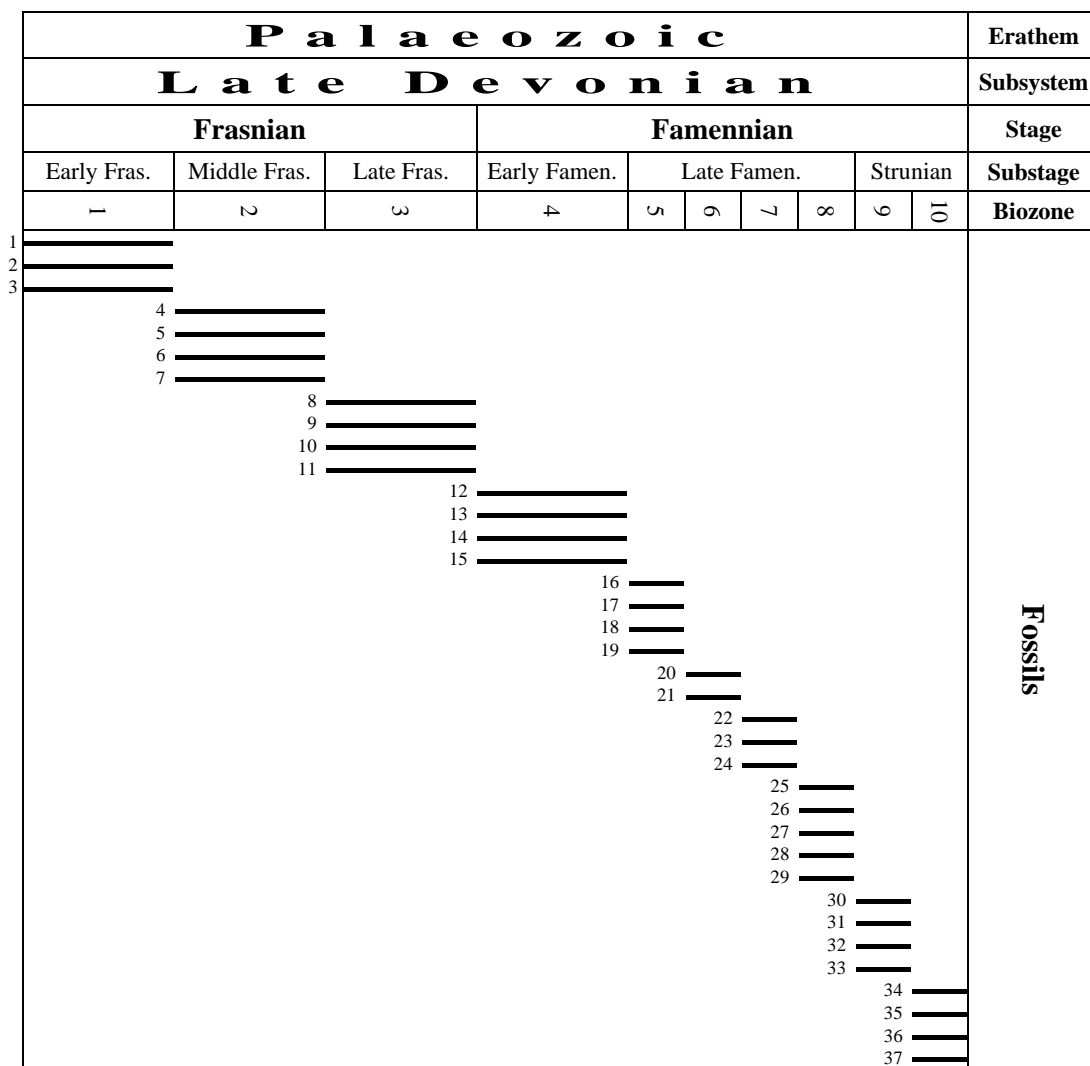


Figure 2. Stratigraphical correlation of some sections in Alborz and Central Iran.



- | | |
|--|---|
| <ul style="list-style-type: none"> 1- <i>Crytina heteroclita pedunculata</i> Brice 2- <i>Hexagonaria</i> sp. 3- <i>Conularia</i> sp. 4- <i>Cyphoterorhynchus koraghensis</i> (Reed) 5- <i>C. koraghensis interpositus</i> Sartener 6- <i>Spinatrypina chitralensis</i> (Reed) 7- <i>Spinatrypina robusta</i> Copper 8- <i>Ripidiorhynchus elburzensis</i> (Gaetani) 9- <i>Cyrtospirifer</i> gr. <i>Verneuili</i> nov. subsp 10- <i>Spinatrypina</i> gr. <i>bodini</i> (Mansuy) 11- <i>Michelinoceras</i> cf. <i>pelops</i> Hall 12- <i>Cyrtospirifer asiaticus</i> Brice 13- <i>Productella baitalensis</i> Reed 14- <i>Spinulicosta robertsoni</i> (Reed) 15- <i>Centrorhynchus</i> cf. <i>baitalensis</i> (Reed) 16- <i>Centrorhynchus turanica</i> (Romanowski) 17- <i>Centrorhynchus charakensis</i> Brice 18- <i>Schizophoria impressa</i> (Hall) 19- <i>Cyrtipsis</i> aff. <i>graciosa</i> (Grabau) | <ul style="list-style-type: none"> 20- <i>Paurogastoredrhynchus nalivkini</i> (Abramian) 21- <i>Cyrtospirifer</i> gr. <i>Verneuili</i> (Morchison) 22- <i>Gastrodetoechia iranica</i> Gaetani 23- <i>Aulacella interlineata</i> (Sow.) 24- <i>Megalopterorhynchus</i> sp. 25- <i>Mesoplica praelonga</i> (Sow.) 26- <i>Leptaena</i> gr. <i>rhomboidalis</i> (Wilckens) 27- <i>Leptagonia</i> sp. 28- <i>Eobrachythyris strunianus strunianus</i> (Gosselet) 29- <i>Enchondrospirifer</i> sp. 30- <i>Cleiothyridina colorodensis</i> (Girty) 31- <i>Cleiothyridina transversa</i> (Stainbrook) 32- <i>Tenticospirifer tenticulom</i> (Verneuili) 33- <i>Phacops</i> cf. <i>bergericus</i> 34- <i>Schuchertella radialis</i> (Phillips) 35- <i>Schuchertella rugosa</i> Girty 36- <i>Cyrtospirifer crassiplicatus</i> Brice 37- <i>Toryniferella echinulata</i> Brice |
|--|---|

Figure 3. Biozonation of the Late Devonian brachiopods in Iran.

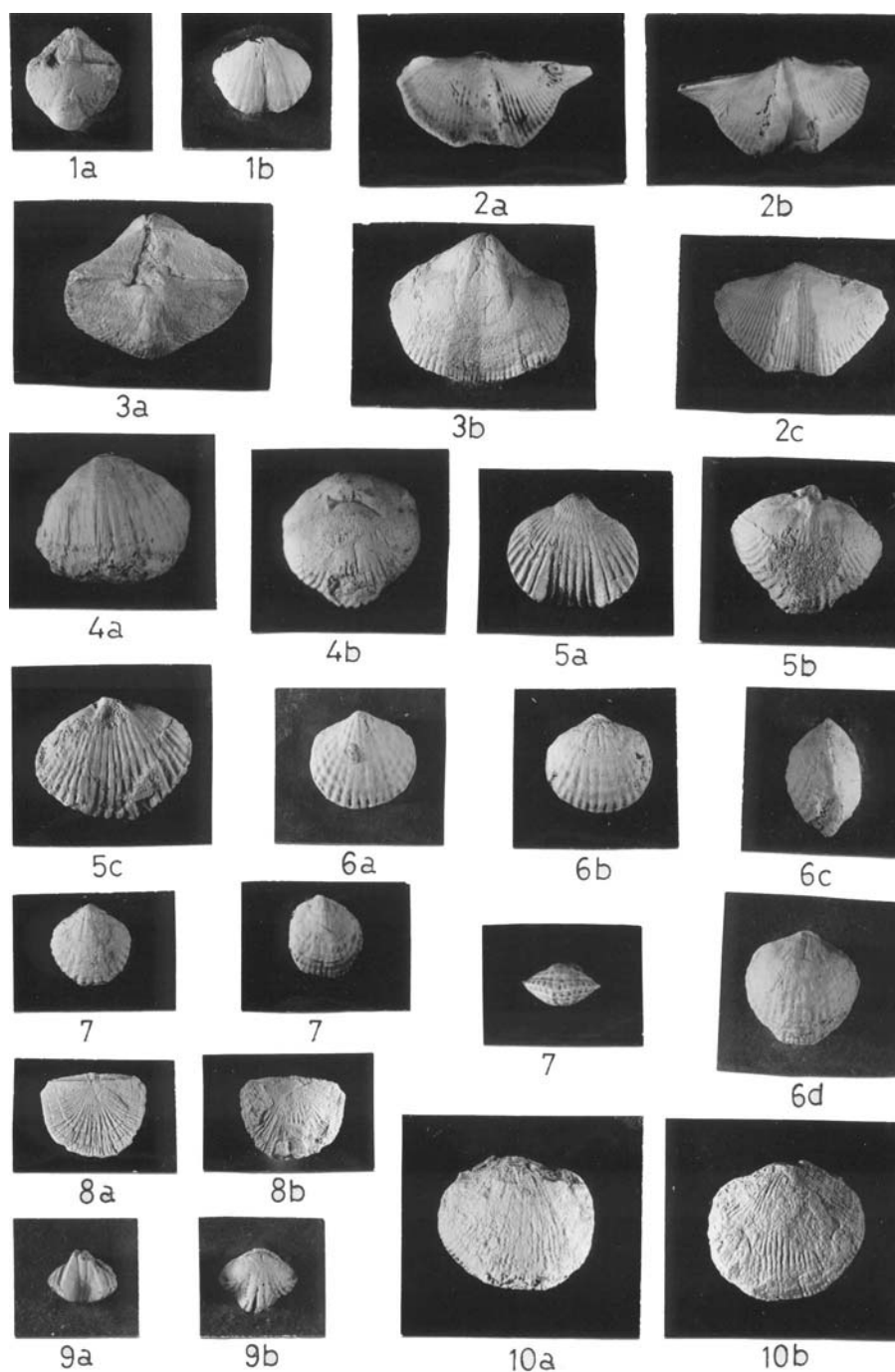


Plate 1. Index Brachiopoda of Middle and Late Frasnian from Chah-Richeh area, NE Esfahan

- 1 (a-b): *Cyrtina heteroclita pedunculata* [6]
- 2 (a-b): *Cyrtospirifer* gr. *verneuli* subsp. nov.
- 3 (a-b): *Cyrtospirifer* gr. *verneuli*
- 4 (a-b): *Cyphoterorhynchus arpaensis* [2]
- 5 (a-c): *Cyphoterorhynchus koraghensis interpositus*
- 6 (a-d): *Spinatrypina chitralensis* [28]
- 7 (a-b): *Spinatrypina* cf. *bodoni*
- 8 (a-b): *Douvilina* sp.
- 9 (a-b): *Ripidiorhynchus elburzensis* [12]
- 10 (a-b): *Spinatrypa robusta*

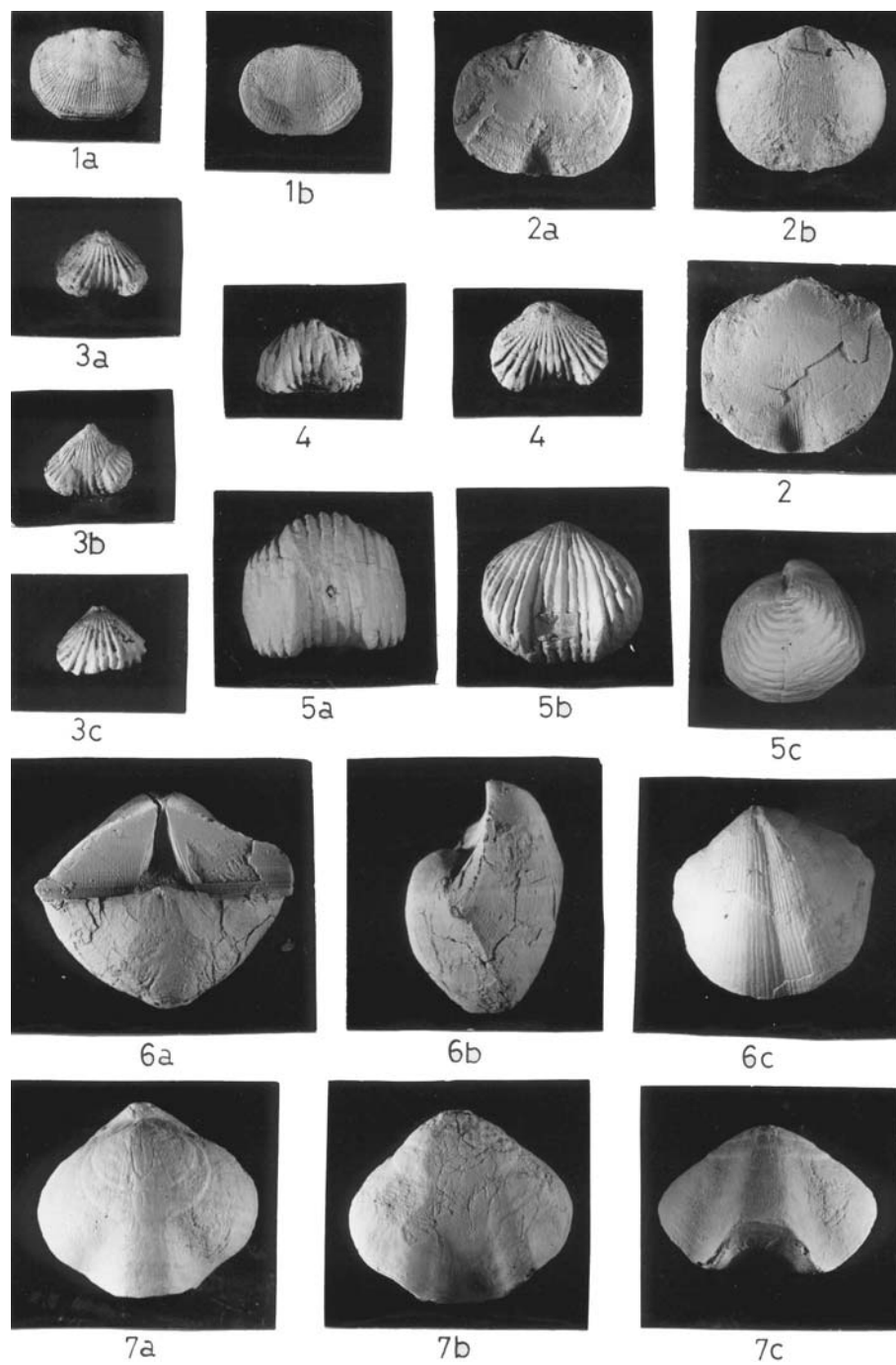


Plate 2. Index Brachiopoda of Middle Famennian from Chah-Richeh area, NE Esfahan

- 1 (a-b): *Aulacella interlineata*
 2 (a-c): *Schizophoria impressa*
 3 (a-c): *Centrorhynchus charakensis* [6]
 4 (a-b): *Centrorhynchus turanica*
 5 (a-c): *Paugastroderhynchus nalivkini* [2]
 6: *Cyrtospirifer wangi* subsp. nov.
 7 (a-c): *Athyris* gr. *concentrica*

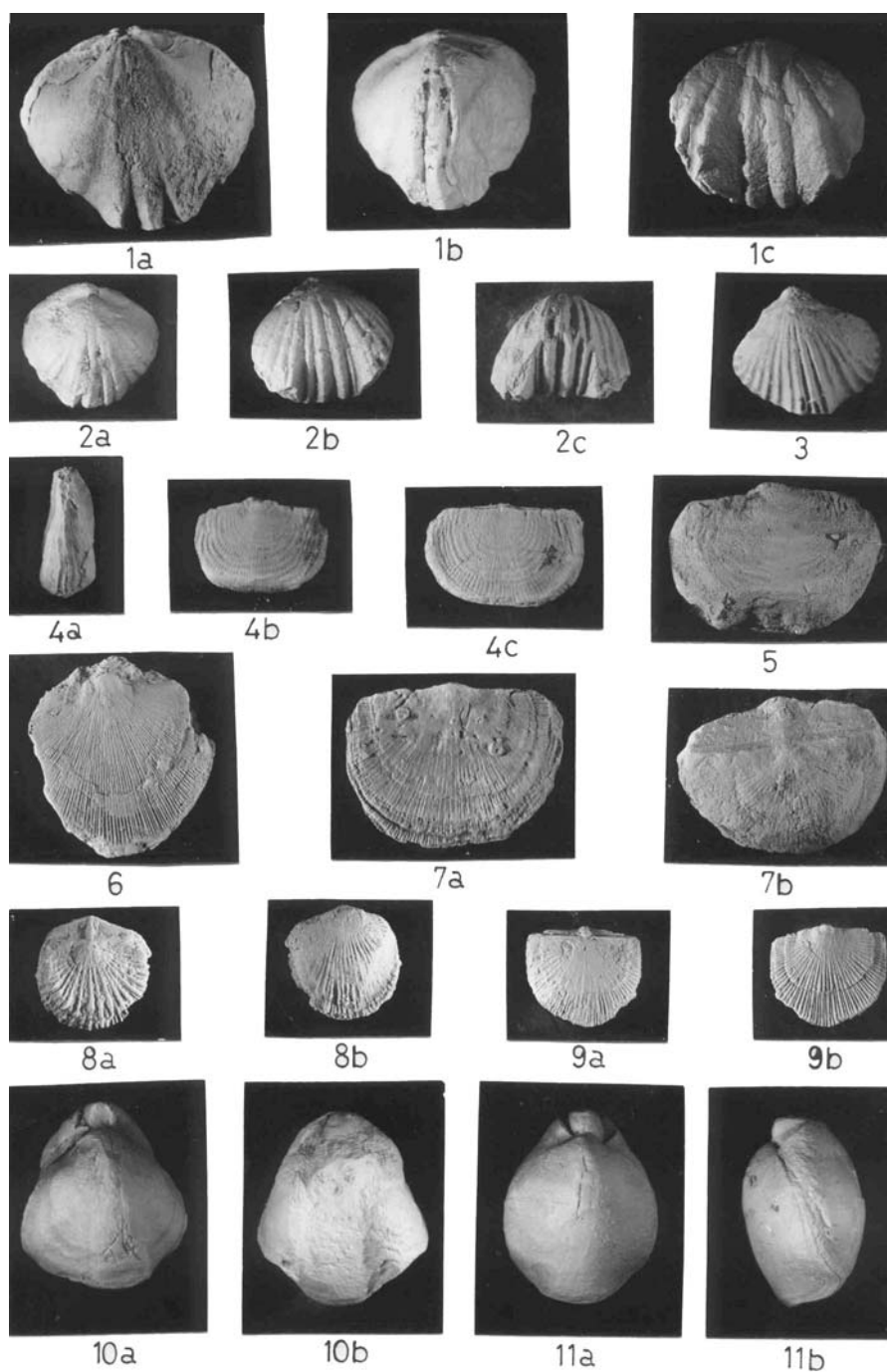


Plate 3. Index Brachiopoda of Late Famennian and Strunian from Chah-Riceh area, NE Esfahan
 1 (a-c): *Megalopterorhynchus* sp. nov.
 2 (a-c): *Gastrodetoechia dichotomian dichotomian*
 3: *Gastrodetoechia* sp.
 4 (a-c): *Leptagonia* sp. nov.
 5: *Leptagonia* gr. *analoga*
 6: *Schelwienella* aff. *percha*
 7 (a-b): *Schuchertella* sp.
 8 (a-b): *Schuchertella radialis*
 9 (a-b): *Schelwienella* sp.
 10 (a-b) & 11 (a-b): *Athyris (Drovithyris)* genus nov. and sp. nov.

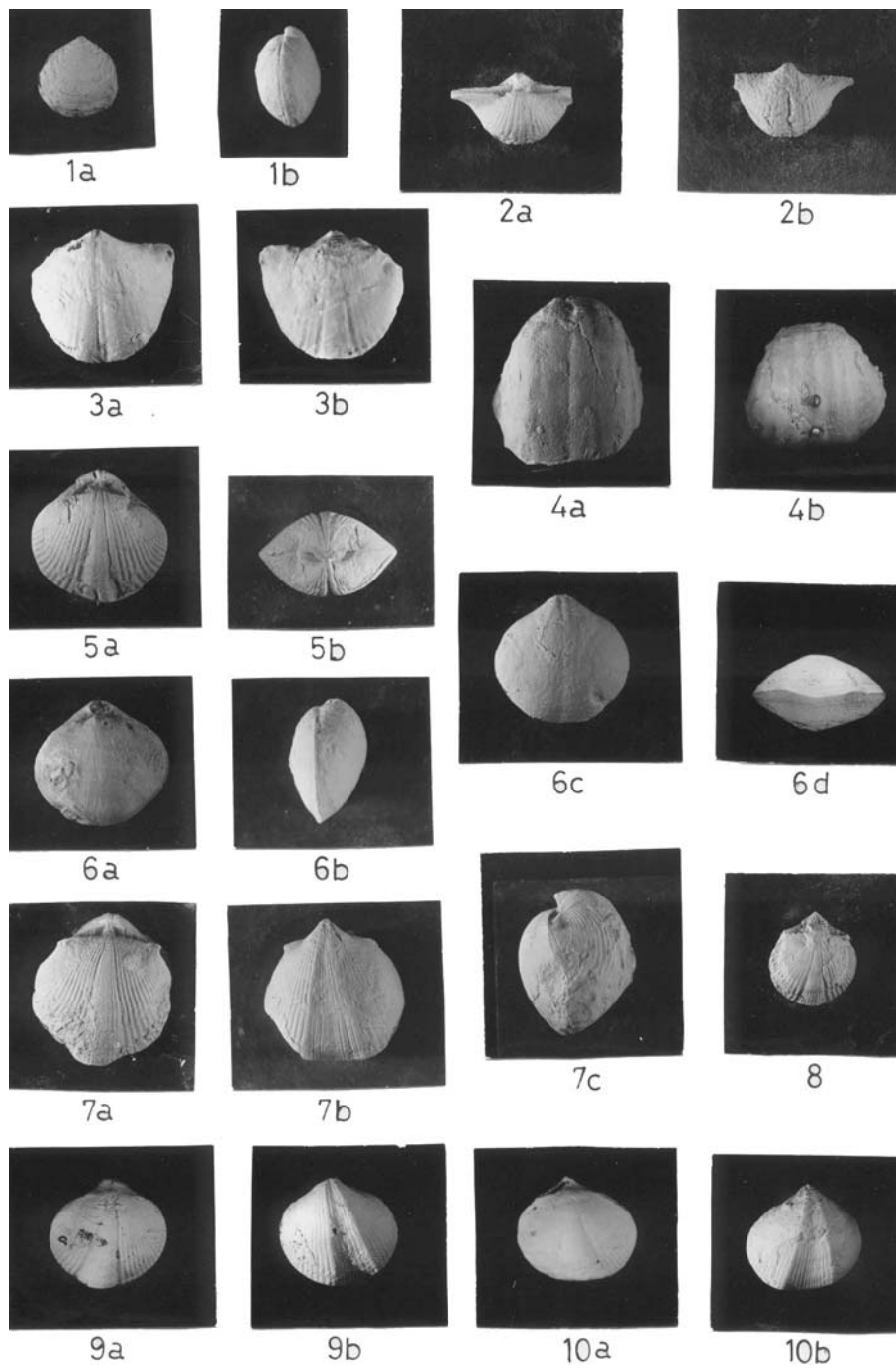


Plate 4. Index Strunian Brachiopoda from Chah-Richeh area, NE Esfahan

- 1 (a-b): *Cleiothyridina coloradensis* [15]
- 2 (a-b): *Eobrachythyris strunianus alatus*
- 3 (a-b): *Eobrachythyris strunianus strunianus*
- 4 (a-b): *Mesoplica praelonga*
- 5 (a-b): *Eobrachythyris* sp. nov.
- 6 (a-d): *Athyris intermedia*
- 7 (a-c): *Cyrtiopsis* gr. *graciosa*
- 8: *Cyrtiopsis* gr. *graciosa charakensis*
- 9 (a-b): *Platyspirifer* cf. *minutus*
- 10 (a-b): *Platyspirifer minutus*

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