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GUIDE TO EXCURSION A2
SARMATIAN OF THE MOLDAVIAN PLATFORM

by

Liviu Ionesi, Bica Ionesi, Mihai Brânzilă,
Natalia Trelea, Petru Ştefan, Viorel Ionesi

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Editorial Office:
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Str. Caransebeş No. 1
RO – 79 678 Bucureşti – 32
Tel. (+40) 1 665 66 25, 665 75 30
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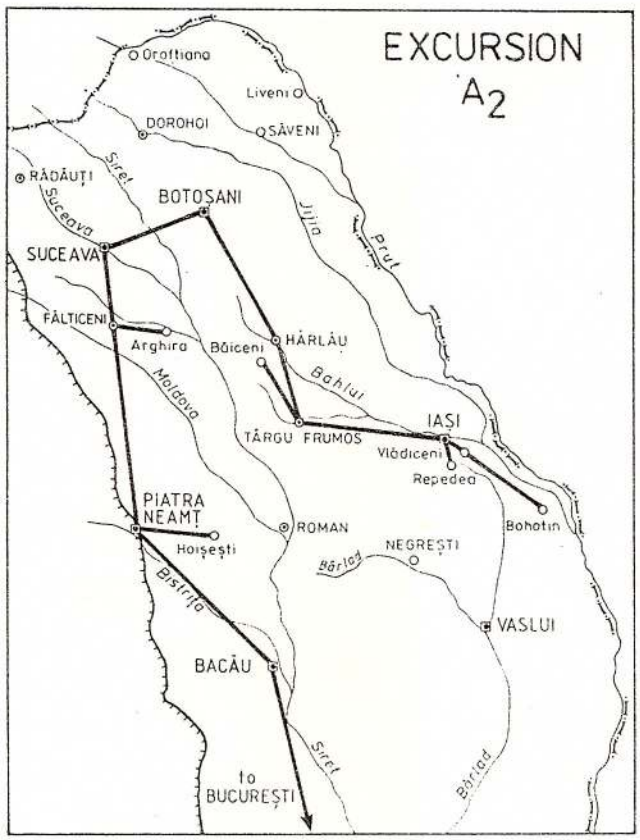

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SARMATIAN OF THE MOLDAVIAN PLATFORM

Liviu IONESI, Bica IONESI, Mihai BRÂNZILĂ,
Natalia TRELEA, Petru ŞTEFAN, Viorel IONESI
Universitatea "Al. I. Cuza", catedra Geologie-Paleontologie, Bdul. Copou nr. 20 A, 6600 Iaşi

Part 1 - General Data (*L. Ionesi*)

1. Introduction

In the Moldavian Platform (the south-western part of the East European Platform) the Sarmatian terranes are widely spread. Excepting a narrow strip in the north-eastern part, where Badenian and Cenomanian deposits are cropping out in the right side of the Prut River (between Oroftiana and Liveni), and in the southern part, where Meotian deposits are preserved in the high hills, the remainder of the platform is occupied by the Sarmatian. On the Sarmatian deposits (clays and sands with thin levels of sandstones and limestones), which dip slightly (4–7 m/Km) toward the south-east, a relief constituted of hills, named the "Moldavian Plateau", has formed. The hydrographic network which penetrates this plateau is drained toward the Siret and Prut rivers.

The Sarmatian of the Moldavian Platform includes the interval between the Upper Badenian (Kossovian) and Meotian, which in the Tethys is an equivalent to the Upper Serravallian and Lower Tortonian.

The researches on the Sarmatian terranes in the Moldavian Plateau were initiated by Gr. Cobălcescu (the founder of the Romanian geology) in the last century (1862, 1883) and they were continued by I. Simionescu, R. Sevastos, M. David, Th. Văscăuţeanu, I. Atanasiu, N. Macarovici, E. Saulea. They still represent a concern of the Geology-Paleontology Department of the "Al. I. Cuza" University of Iaşi (P. Jeanrenaud, B. Ionesi, N. Trelea, L. Ionesi, Th. Simionescu, P. Ştefan, M. Brânzilă, P. Ţibuleac, etc.)

2. Badenian-Sarmatian boundary. It can be followed in the north-eastern part of the Moldavian Platform in the outcrops in the right side of the Prut (between Oroftiana and Liveni) and in the remainder of the Platform, according to the drilling data. This boundary is trenchant and it corresponds to the replacement of the normal salinity fauna of the Upper Badenian (*Chlamys, Glycymeris, Lucina, Megerlea, Spiratella, Urigerina, Bulimina* etc.) by the brackish fauna typical of the Sarmatian. This substitution is not gradual, but sudden (Figs. 1, 2, 3) the Sarmatian fauna being quite evolved. The following of the brackish fauna and of the lithology (the lack of lithologic units in the base of the Sarmatian) stressed out that a short sedimentary gap (Ionesi and Ionesi, 1982, 1983) occurred in the Moldavian Platform between the Upper Badenian (Kossovian) and the Sarmatian. In fact, this gap was in the whole foreland in front of the Romanian Carpathians but it is more obvious in the Moesian

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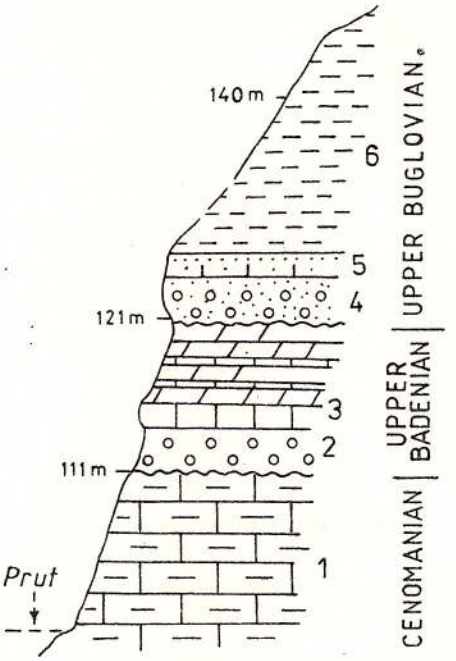

Fig. 1 – Geologic section in the right bank of the Prut River at Cotul Zamca (according to Ionesi, Ionesi, 1982). Cenomanian: 1, flint limestones. Badenian: 2, conglomerates; 3, limestones and marls with *Lithothamnium*. Buglovian: 4, sandstones, sands and conglomerates (with reworked *Lithothamnium* fragments); 5, sandstones with *Mactra, Ervilia*, etc.); 6, Darabani-Mitoc benthonic clays.

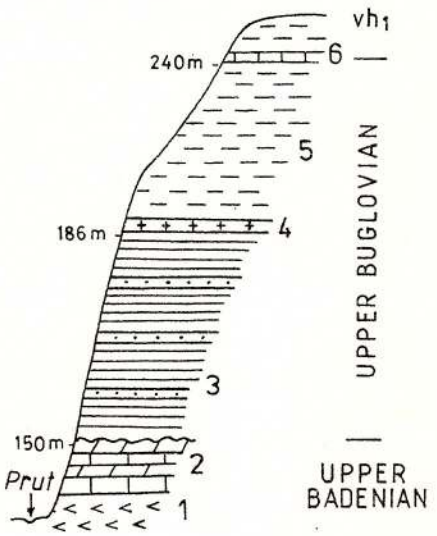

Fig. 2 – Geologic section in the right bank of the Prut River at Cuzlău (according to Ionesi, Ionesi, 1982).
Badenian: 1, gypsum; 2, limestones and marls with *Lithothamnium*. Buglovian: 3, Bajura illite clays; 4, Hudeşti dacitic tuff; 5, Darabani-Mitoc benthonic clays; 6, Eşanca limestones.

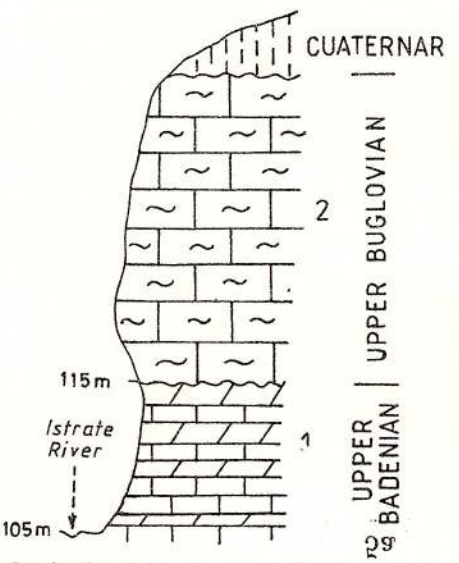

Fig. 3 – Geologic section on the Istrate Brook (according to Ionesi, Ionesi, 1982).
Badenian: 1, marls and limestones with *Lithothamnium*. Buglovian: 2, limestones with *Serpula*. Q-Quaternary.

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Platform (South Dobrogea and Wallachian Platform).

3. Sarmatian-Meotian boundary. It is marked by the disappearance of the small mactra fauna (*M. caspia, M. bulgarica* etc.) and the appearance of the fauna with *Congeria panticapaea, Unio moldavicus, U. wetzleri* etc. According to Jeanrenaud (1971) this event took place before the sedimentation of the Nuţasca-Ruseni andesitic tuff and therefore it becomes a significant lithostratigraphic marker for the base of the Meotian.

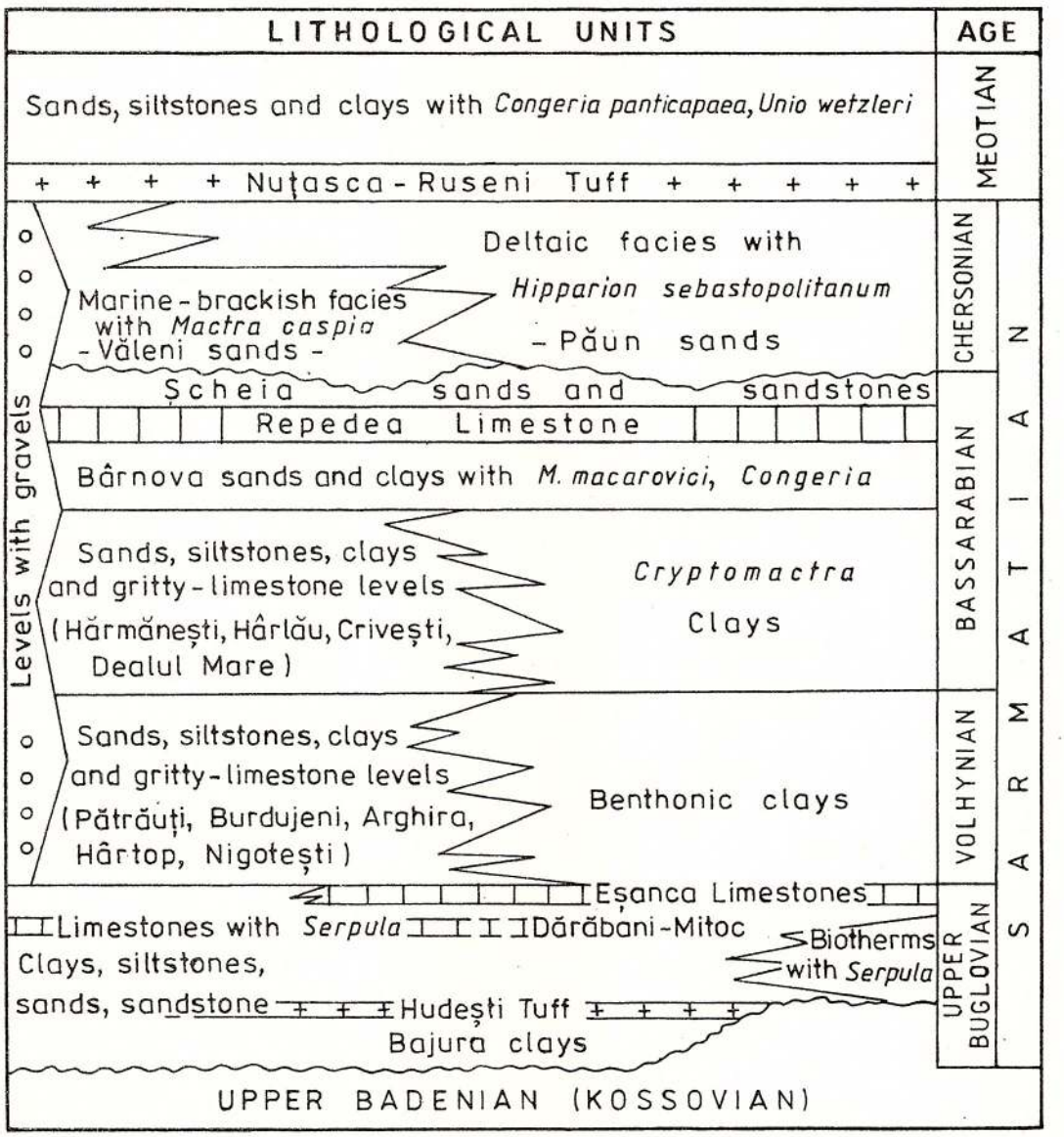

Fig. 4 – Lithological units of the Moldavian Platform Sarmatian.

Lithologic aspects. The Sarmatian in the Moldavian Platform consists especially of clays, siltstones and sands, with intercalations, at larger or smaller intervals, of thin levels of sandstones, oölitic limestones (oösparites), biosparites and gritty limestones. In the western part, at the contact with the Carpathian land, rudites associated with sands (regarded as deltaic depositions) occur, as well. In the first part of the Lower Sarmatian, on a narrow strip on

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the eastern side (at present parallel to the Prut), occur small bioherms, constituted of tubicle worms (*Serpula*) and bryozoa, which represent the southernmost part of the bioherms in Podolia. In the north-eastern sector, the Lower Sarmatian includes a level (2–5 m) of dacitic tuff (Hudeşti tuff). In the same sector, particularly over the tuff, there are thin intercalations of bentonites (< 15 cm). The thickness of the Sarmatian deposits varies between 800 m in the east and 2600 m in the west. The separated lithologic units are rendered in Figure 4.

Fauna and flora. In the interval between the Kossovian and the Meotian the brackish fauna prevails, which is represented by foraminifers, bryozoa, tubicle worms, bivalves, gastropods, mysids and ostracods. Skeletic remains of fishes and cetaceans are also found. The foraminifers (*Porosononion, Elphidium, Ammonia, Dogiela* etc.), bivalves (*Ervilia, Mactra, Tapes,* cardiids) and gastropods (*Mohrensternia, Potamides, Barbotella*) are significant for the biozonation of the Sarmatian and the correlation of the heteropic facies.

The fauna content depended on the decrease of the salinity. In the first part of the Lower Sarmatian (Buglovian in our opinion) some Badenian relics still exist (*Ocenebrina, Polinices, Corbulamella*, etc.), and in the Upper Sarmatian (Chersonian) most of the brackish fauna disappears, except the small mactras (*M. caspia, M. bulgarica*, etc.) and the ostracods.

There are also regional or general exceptions. Thus, in the Upper Volhynian, in the Fălticeni-Baia-Boroaia sector, where coal beds occur, in certain cases they are underlain or overlain by a fresh water fauna with *Anodonta, Planorbis*, etc. Fresh waters existed in the Chersonian as well, the respective deposits being known as deltaic lithofacies (Jeanrenaud, 1971).

During the Upper Bassarabian the salinity decreased strongly (for a short period of time), which determined the appearance of a small mactra fauna – *Congeria, Melanopsis, Theodoxus, Viviparus*, etc. – followed by a brackish one with *Plicatiforma fittoni, Mactra fabreana*, etc. (see the Răducăneni outcrop). Within the same interval levels with fresh-water fauna (*Anodonta, Unio*, etc.) are also found.

The Sarmatian of the Moldavian Platform also includes "mixture" faunas - e.g. at Bohotin (stop 3), where within an assemblage with *Pl. fittoni, M. fabreana, Barbotella*, etc. also occur species of *Unio, Congeria, Melanopsis*, etc. (considered to originate in another biotop), or at Văleni in the Văleni sands (stop 8), where small Bassarabian species are found beside numerous small Chersonian mactras. The mixture is considered either as a "transition horizon" from the Bassarabian to the Chersonian (Martiniuc, 1948; Macarovici, 1954) or due to resedimentation (Ionesi and Ionesi, 1976).

Besides the brackish or fresh water faunas there are also terrestrial faunas represented by molluscs (*Helix, Cepaea*) and particularly by mammals. Thus, in the Upper Volhynian a fragment of *Gazella* horn has been found in a coal bed (P. Ţibuleac and V. Codrea, new data); in the Lower Bassarabian (biozone with *M. pallasi* and *T. gregarius ponderosus*), at Hârlău, a molar of *Dinotherium giganteum* (Macarovici, 1978); in the Upper Bassarabian, molars of *Hipparion sarmaticum, Aceratherium incissivum*, and in the Chersonian *Hipparion sebastopolitanum, Aceratherium incissivum, Ichtitherium hipparionum, Lagomeryx* cf. *flerovi* (Macarovici, 1978; Cochior, Nechita, 1993; Lungu et al., 1995; Simionescu, Trelea, 1991).

Among the plants dasycladacean algae (*Acicularia*), characeae and particularly imprints of tree and shrubs leaves are to be found. Thus, taxa of *Carpinus, Betula, Alnus, Osmunda*, etc. (Barbu, 1934) have been determined in the Upper Volhynian, and taxa of *Alnus, Quercus, Laurus, Populus, Platanus*, etc. in the Chersonian (Macarovici, Paghida, 1966).

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4. Sarmatian substages (bionomic content, lithology, spreading)

The separation of the Sarmatian substages in the Moldavian Platform does not raise special questions as concerns the boundaries, the bionomic content and the bryozoa.

The lower part of the Santonian, known as "Buglovian", constitutes an exception. It is worth mentioning that this unit was identified on the Moldavian Platform, and Atanasiu (1945) convincingly demonstrated the necessity of its separation. After the revision made by Vialov and Griskevici (1965) the researchers in Iaşi further supported the idea of maintaining this substage (Macarovici et al., 1967, 1970; Ionesi, 1968, pp. 71–78; Paghida-Trelea, 1969, pp. 64–68). Of course, the maintenance of the Buglovian should be regarded as a point of view. As a matter of fact, some other authors also maintain the Buglovian, whithout any comments (Vengliski, 1975; Bobrinskaja, 1986).

The Buglovian on the Moldavian Platform is represented by deposits with brackish fauna, within which a few Badenian relics (*Ocenebrina sublavata, O. striata, Polinices catena helicina, Spaniodontella sp., Corbulamella sp., Cibicides badenensis, C. lobatulus, Cytheridea acuminata*, etc.) still persist. One should also mention several characteristic taxa such as *Inaequicostata inopinata, Obsoletiforma ruthenica, Abra alba scythica, Terebralia andrzjowskii, Mohrensternia* div. sp., striated milliolids (*Q. kererri ovata, Q. fluviata).* The *Cibicides lobatulus* and *C. badenensis* acme should be also pointed out.

Deposits containing such fauna crop out in the north-western part of the platform (where the relationships with the Upper Badenian are also visible) (Figs. 1, 2) as well as between the Siret and Suceava valleys (where only the upper part is exposed). Lithologically the clays prevail. Biothermus with *Serpula* and Bryozoans formed in the north-eastern part between Mitoc and Ştefăneşti, overlying either the benthonic clays (with brackish fauna) or directly Badenian marls and limestones with *Lithothamnium* (Fig. 3). It should be reminded that a sedimentation break existed between the Badenian and the Sarmatian.

The Volhynian (s. s.) comes next, cropping out over a large area in the northern part of the platform. The outcrops at Burdujeni and Arghira are Volhynian deposits (stop 6). Some of the characteristic taxa are: *Ervilia, Plicatiforma plicata, P. latisulca, Mactra eichwaldi, Ineaquicostata gleichenbergense, Tapes tricuspis, Potamides mitralis, P. nimpha, Articulina sarmatica*, etc.

Lithologically clays prevail in the eastern half, while in the western half they alternate with sands and limestone and sandstone levels (Pătrăuţi, Burdujeni, Arghira, Nigoteşti); rudites occur at the contact with the orogen. Several lignite beds (three of them ranging between 20–80 cm in thickness) are to be found in the Fălticeni-Baia-Boroaia region in the Upper Volhynian. The coals come from peat bogs, preceded or not by lacustrine phases, with fresh-water fauna (*Anodonta, Unio*, etc.), which suggests that the respective zone underwent several oscillations.

Bassarabian. Under the conditions of a sedimentation continuity the Volhynian-Bassarabian boundary is marked by the disappearance of the taxa characteristic of the Volhynian and the occurrence of the taxa *Tapes gregarius ponderosus, Mactra pallasi* and *Cryptomactra pesanseris* (the latter being located exclusively in the pelitic facies from the eastern part) (Ionesi, 1980) (Fig. 5). Later on some other index species (*M. fabreana, M. naviculata, Plicatiforma fittoni, Obsoletiforma löweni, Barbotella, Gibbula beaumonti, Sarmatiella, Dogielina*, etc.) also occur. The Bassarabian deposits crop out over a larger area in the central part of the Moldavian

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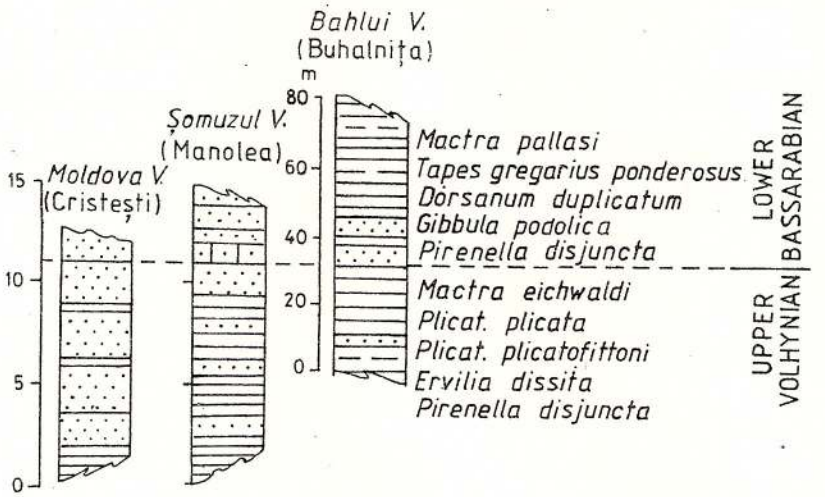

Fig. 5 – Biostratigraphic details at the Volhynian-Bassarabian boundary of the Moldavian Platform (according to.Bica Ionesi, 1980).

Platform. Lithologically, during the Lower Bassarabian and partly in the Upper Bassarabian a pelitic sedimentation – the *Cryptomactra* clays - took place in the eastern part of the platform, while in the western half, this facies was replaced by a prevailingly sandy sedimentation, with sandstone and limestone levels (Hărmăneşti, Hârlău, Criveşti, Dealul Mare). Subsequently, as a consequence of an uplifting movement, the northern half becomes land (on which the fauna with *H. sarmaticum* appears), while in the south the weakly brackish basin sets in, with small mactras and congeria and a prevailingly sandy sedimentation (the Bârnova sand). At the end of the Bassarabian the brackish waters with specific fauna (*M. fabreana, Pl. fittoni, Barbotella*, etc.) recur, with a neritic-littoral sedimentation (the Repedea gritty-limestone, the Scheia sands and sandstones). Jeanrenaud (1971) achieved a detailed age determination of the Bassarabian deposits from the Moldavian Platform. Observations on the Bassarabian formations will be made in: the clays with *Cryptomactra* (Voineşti-Jassy), the deposits with small mactras and congeria (Răducăneni), the Repedea gritty-limestone with *Pl. fittoni, M. fabreana*, etc. (Repedea-Jassy, Răducăneni, Bohotin), and the deposits with *M. pallasi* and *Tapes gregarius ponderosus* (Băiceni-Cotnari).

Chersonian. In my opinion, there existed a short sedimentation break between the Bassarabian and the Chersonian (Ionesi and Ionesi, 1994). This phenomenon is much more obvious on the Moesian Platform (South Dobrogea and the Wallachian Platform). This explains the radical change in the fauna and some reworkings of the Bassarabian fauna in the base of the Chersonian (Văleni sand). During the Chersonian sedimentation was prevailingly arenitic (sands). Jeanrenaud separated the Chersonian sands in two facies: a brackish facies with small mactras (*M. caspia, M. bulgarica*, etc.), and a deltaic one, devoid of mactras but in which molars and skeleton remains of *Hipparion sebastoplitanum, Aceraterium incissivum, Icthitherium hipparionum* and leaf imprints were found (Macarovici, Paghida, 1966; Macarovici, 1978). The

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Chersonian occurs only in the southern part of the Moldavian Platform. Chersonian deposits with small mactras but also with reworkings of Bassarabian fauna will be examined at Văleni.

The biozonation of the Sarmatian on the Moldavian Platform was achieved based on the

AGE			BIVALVIA		GASTROPODA		FORAMINIFERIDA		OSTRACODA	
SARMATIAN		CHERSONIAN	*Mactra bulgarica* *Mactra orbiculata*		—		*Ammonia beccarii*		*Cyprideis pannonica* *Candona sublabiata* *Leptocythere paralella*	
	BASSARABIAN	UPPER	*Plicatiforma fittoni*		*Gibbula beaumonti*		*Spirolina, Dendritina* *A.beccarii, Quinqueloculina*		*Cyprideis pannonica* *Myocyprideis janoscheki*	
			Facies with *Congeria* *M. macarovici, Congeria, Hydrobia, Neritina*				Facies with *Congeria*		*Cypr. pannonica*	
			Mactra fabreana	*Cryptomactra pesanseris* *Chartocardium barboti*	*Barbotella* ?	*C. moldavicum* *Barbotella*	*Porosononion subgranosus* *Elphidium macellum*	Facies with *Dogielina sarmatica* *Sarmatiella moldaviensis* *Paramysus*	*Cryptomactra*	*Aurila kolesnikovii*
		LOWER	*Mactra pallasi* *Tapes gregarius ponderosus*			*P. disjunctus* *G. podolica* *D. duplicatum*			?	*Aurila mehesi* *Leptocythere praebosqueti trassae*
	VOLHYNIAN	UPPER	*Plicatiforma plicata* *Mactra eichwaldi*		*Potamides mitralis* *Potamides nimpha*		*Elphidium rugosum* *Quinqueloculina consobrina* *Ammonia beccarii*		*Leptocythere mironovi*	*Xestoleberis elongata*
		LOWER	*Ervilia*	*Inaequicostata pia* *In. gleichenbergense* *Obs. lithopodolica*	*Potamides bicostatus*		*Quinqueloculina reussi* *Articulina sarmatica*			*Xestoleberis lutrae* *Leptocythere bosqueti*
	UPPER BUGLOVIAN		*In. inopinata* *Obs. ruthenica*		*Mohrensternia sp. div.* *Ocenebrina sublavata* *Polinices catena helicina*		*Cibicides lobatulus* *Quinqueloculina fluviata* *Q. karreri ovata*		*Cytheridea acuminata* *Pontocypris declivis*	

Fig. 6 – Biozonation of the Moldavian Platform Sarmatian (according to Bica Ionesi, 1991).

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bionomic inventory of bivalves, gastropods, foraminifers and ostracods, the frequency and especially the characteristic species being taken into consideration (Fig. 6). It is to note that in respect of the eastern part of the platform, the boundary between the Volhynian and the Bassarabian respectively, is not yet clear. Also, it is not known whether the facies with small mactras and congeria from the Upper Bassarabian extends or not to the peri-Carpathian molasse (Carpathian orogen).

Geodynamic processes. During the Sarmatian more or less intense geodynamic processes took place. Thus the sedimentation break between the Badenian and the Sarmatian can be correlated with the Moldavian movements, the compression effects of which led to the tectonic overlap of the western margin of the platform (30–50 km) by the Carpathian Orogen. This process started after the Kossovian and ented in the Lower Volhynian, where the present space of the platform outlined, and the deltaic ruditic sedimentation began at the contact with the Carpathian land.

In the Upper Volhynian the Fălticeni-Baia-Boroaia sector underwent repeated exundations with the appearance of peat bogs, preceded or not by fresh water lakes.

In the Upper Bassarabian important paleogeographic changes took place, which were brought about by an uplifting movement that ended in the transformation into land of the northern half and the isolation of a basin between this land and the North Dobrogea-Crimeea barrier, of much lower salinity (fauna with small mactras and congeria), and an arenitic sedimentation. In the same paleogeographic framework the brackish waters recur towards the end of the Bassarabian and subsequently a short sedimentation break took place between the Bassarabian and Chersonian. The retirement of the waters from the northern part of the platform took place after the Middle Pontian.

The slight inclination of the Sarmatian deposits is due to a differentiated uplifting movement that manifested at the end of the Pannonian (Wallachian phase).

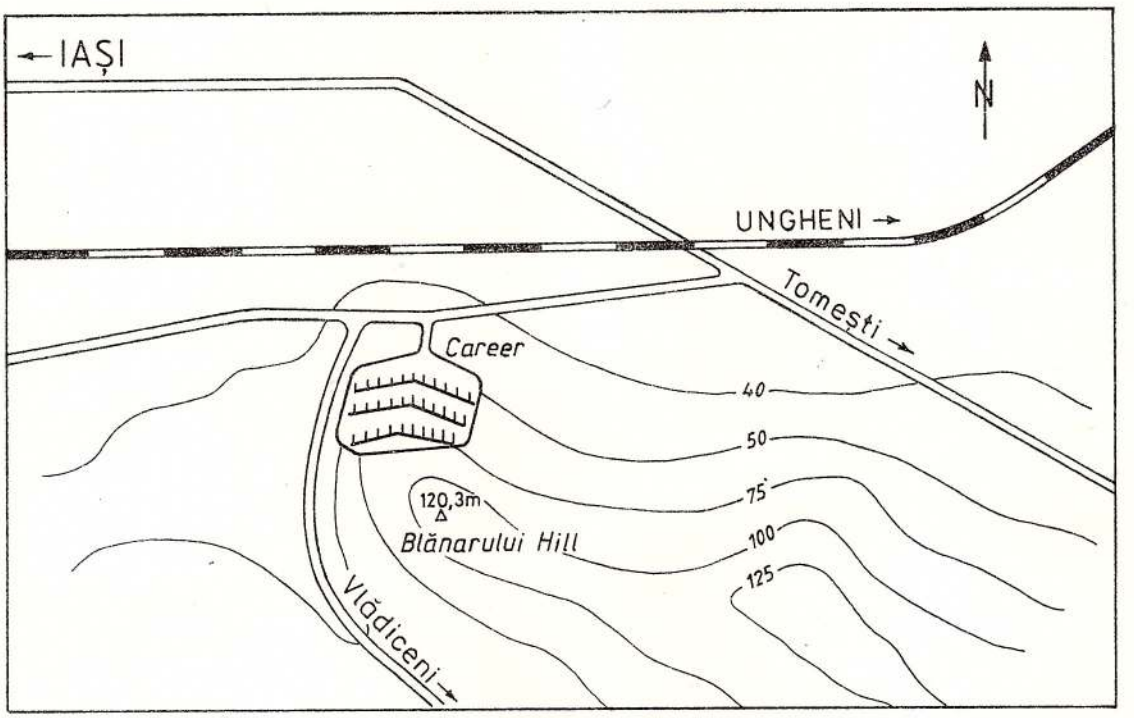

Fig. 7 – Location of the Tomeşti-Vlădiceni quarry.

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Part 2 – Description of Stops

Stop 1 – **The Cryptomactra Clays from the Tomeşti-Vlădiceni Quarry**
(*Mihai Brânzilă*)

The *Cryptomactra* clays are very well exposed in the Tomeşti-Vlădiceni Quarry, situated on the northern slope of the Blănaru Hill, south-east of Iaşi (Fig. 7); geographically it is situated in the southern part of the Moldavian Plain, at the contact with the Moldavian Plateau, this contact being marked by a 200–300 m escarpment. This is the sector in which the pelitic sedimentation from the Volhynian is continued also in the Bassarabian, represented by clays and grey-bluish siltstones with thin argillaceous clay interbeds, a formation described as "*Cryptomactra* clays".

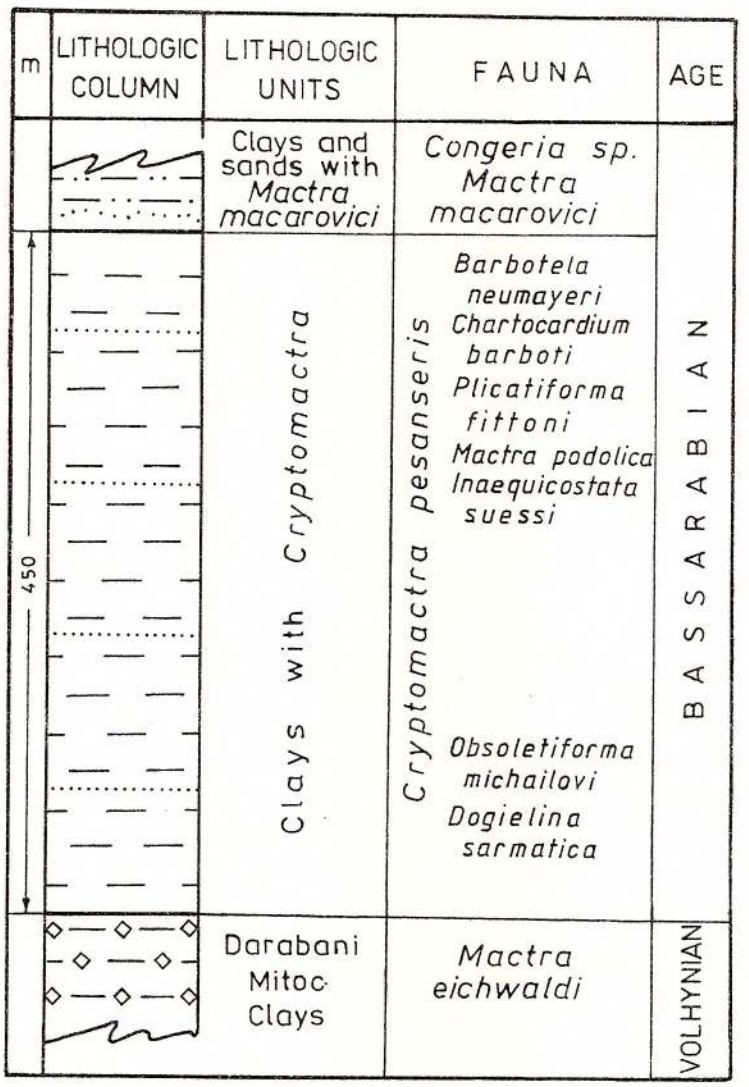

Fig. 8 – Lithobiostratigraphy of the "clays with *Cryptomactra*".

This denomination was introduced by V. P. Kolesnikov (1935), but their description was made by Andrusov (1903) in the Taman Peninsula. The "*Cryptomactra* clays" are largely

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developed in the eastern part of the Moldavian Platform (east of Flămânzi-Tg. Frumos), their thickness being estimated at 450 m. They are situated between the "Darabani-Mitoc type clays" (Volhynian) and the "clays and sands with *Mactra macarovici* and congeria" (Upper Bassarabian). The boundaries are not rigourously specified (Fig. 8). The lower boundary is to be found in the north, approximately in the zone of the Santa Mare locality, the transition being gradual. Some observations on the "*Cryptomactra* clays" were made in several places of the Moldavian Platform; however, different stratigraphic intervals were intercepted, which have a common lithology and fauna, dominated by the genus *Cryptomactra*.

The first observations were made by David (1922), who assigns them to the base of the Sarmatian (Buglovian) but the most important study belongs to Văscăuţeanu (1929), on the Prut River bank at Ungheni, naming them the Ungheni clays, characterized by the presence of *Cryptomactra pesanseris*. Like Atanasiu (1945), the latter author considers them to represent a depth facies.

Other authors that dealt with the *Cryptomactra* clays are: Preda and Saulea-Bocec (1948), Macarovici et al. (1957), Jeanrenaud (1971).

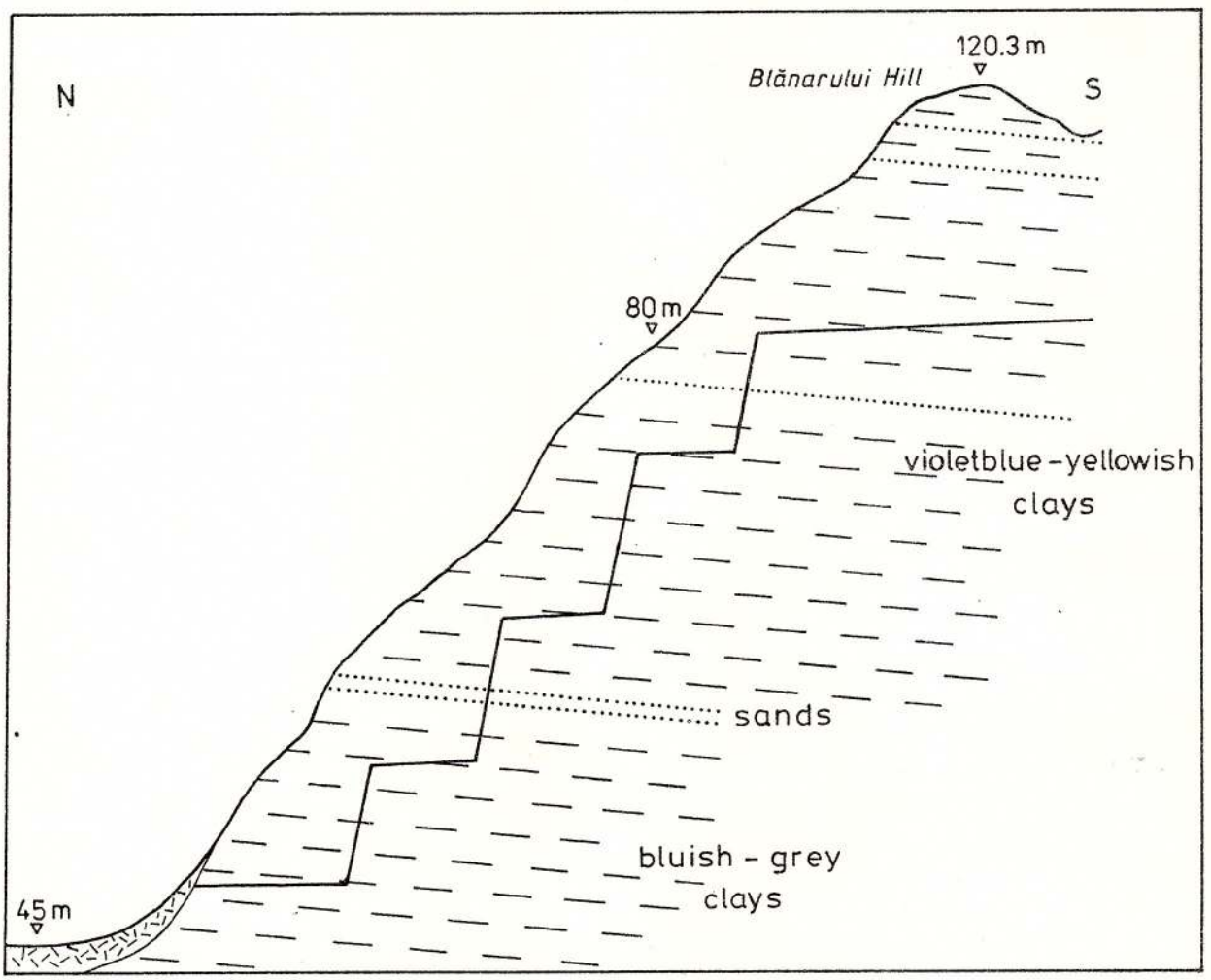

Fig. 9 – Section through the Tomeşti-Vlădiceni quarry.

Paghida-Trelea (1969) points out the scarcity of the fauna, underlining the frequency of the taxon *Cryptomactra pesanseris* and of numerous milliolids, mentioning: *Quinqueloculina*

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voloshinovae BOGD., *Q. brevidentata* VOL., *Q. ovula* KARRER., *Q. consobrina sarmatica* GERKE et ISSAEVA, *Dogielina sarmatica* BOGD. et VOL., *Sarmatiella prima* BOGD., *S. moldaviensis* BOGD., *Porosononion subgranosus* EGGER, *Nubecularia novorossica solitaria* KARRER. et SINZOW, *Globigerina bulloides* D'ORB., *Loxoconcha carinata* LIENKLS, *Cytheruva insinuata* SCHN., *Cryptomactra pensanseris* MAY., *Obsoletiforma michailovi* TOULA, *Plicatiforma fittoni* D'ORB., *Inaequicostata suessi* BARBOT, *Chartocardium barboti* TOULA, *Mactra podolica* EICHW., *Barbotella neumayeri* COB., *Macrurus rotundus* WIELER, *Gobius tenuis* WEILER, *Argentina rumana* WEILER, etc.

The formation comprises a little varied lithology: stratified or massive clays and greybluish siltites with sandy clays interbeds and even centimetric fine sands beds. Locally gypsum crystals are found on the bedding surfaces.

East of the Prut River the *Cryptomactra* clays are overlain by carbonate clays consisting of fine scaly aggregates with montmorillonite hydromicas and carbonate material in the base, and clays and aleurites formed of montmorillonite hydromicas aggregates with a mixture of carbonates and aleurite quartz and mica grains at the top. Coal fragments and fine pyrite crystals disseminated in the rock can be also noticed.

The *Cryptomactra* clays are exposed over a thickness of ca. 50 m in the quarry at Tomeşti-Vlădiceni (Blănaru Hill), representing a pile of deposits situated over those described at Ungheni by Th. Văscăuţeanu and under those at Voineşti (Preda, Saulea, 1948). From the base of the quarry (absolute altitude of 40 m) some vertical variations can be observed. Thus in the base (ca. 15 m) bluish clays are to be found, which contain fauna remains (Fig. 9). They are followed by sands (15–20 cm thick), overlain by bluish-yellowish clays (30–35 m thick) with thin fossiliferous sand interbeds. Over the altitude of 80 m (the last step of the quarry) greyish clays prevail, with ever thicker fine sand and sandy clays interbeds (ca. 80 m).

The fauna encountered in the Tomeşti-Vlădiceni quarry (Blănaru Hill) is poor, consisting of deformed shells such as: *Cryptomactra pesanseris* MAY, *Plicatiforma fittoni* D'ORB., *Chartocardium barboti* TOULA, *Obsoletiforma obsoleta* EICHW., *Inaequicostata suessi* BARBOT, *Mactra* cf.*podolica ovata* IONESI et al., *Potamides* sp., *Gibbula* sp.

The macrofauna assemblage is not marked by the abundance of a certain genus but only by the growth in size of the genus *Cryptomacta.*

The presence of the species *Plicatiforma fittoni, Chartocardium barboti, Inaequicostata suessi* BARBOT permits the assignment of the *Cryptomactra* clays from the Tomeşti-Vlădiceni quarry to the Upper Bassarabian.

Stop 2 – **Sands and Clays with Small Mactras, Congeria Fresh Water Intercalations from the Bassarabian at Răducăneni**

(*Liviu Ionesi, Bica Ionesi*)

The Răducăneni locality lies 45 km from Iaşi on the 28 Iaşi-Huşi highway. The hilly relief (up to 300 m in highness) from the Răducăneni-Bohotin zone constitutes a lower area on the eastern side of the Moldavian Central Plateau in the vicinity of the Prut Valley. The hills are divided by the Bohotin, Moşna, Comarna valleys and their tributaries. The tributaries on the right of the Bohotin Brook (Humăriei, Pietrei, Răducăneni, Hemeiosu) privide exposures. The observations are made on Pârâul Pietrei (north-western part of the Răducăneni locality).

The hills from the Răducăneni-Bohotin zone consist of deposits belonging to the Bassarabian, Chersonian and Meotian. The Bassarabian exposes its upper part consisting of the sands and clays with small mactras, congeria and intercalations of fresh water fauna (*Unio, Anodonta,*

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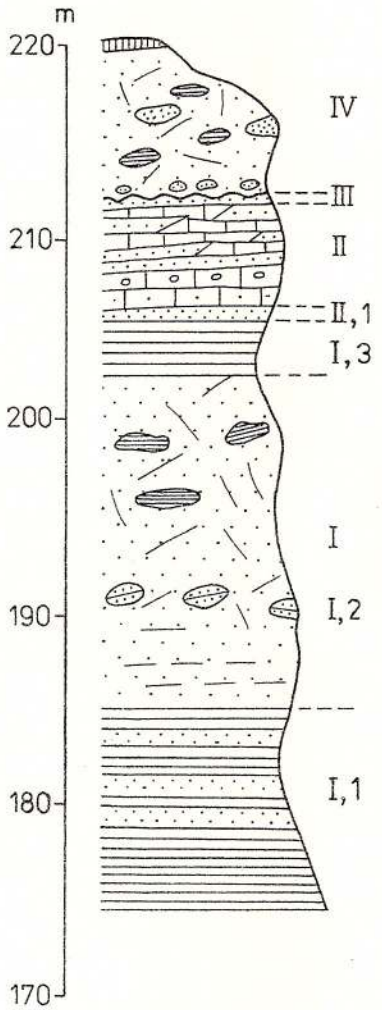

Fig. 10 – Synthetic lithostratigraphic column (Pârâul Pietrei-Răducăneni): 1, sands and clays with small mactras and congerias: I_1, clays and sandy clays with fresh-water fauna; I_2, Bârnova sand; I_3, bluish clays; II, gritty-limestones with *Mactra podolica*: II_1, sandy clays with *Musculus*; III, sands and clays with cerites; IV, sands with calcareous concretions.

etc.) as well as the gritty limestones with *Mactra podolica* (Repedea Limestone), overlain in some outcrops by argillaceous sands with cerits and clays (0.5 m). These are overlain by massive sands, equivalent to those with *Unio* and *Helix*, which we assign to the Chersonian and not to the Upper Bassarabian (Jeanrenaud, 1971). According to this interpretation, the lack of the sands and clays with rare specimens of *Mactra podolica* (< 10 m) as well as of the Scheia sandstones (10–15 m) could be noticed, considered to be caused by a sedimentation break (Ionesi, Ionesi, 1984). In this sense, the sands and the clays with cerits represent a rest that remained unaffected by erosion of the eroded unit.

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On Pârâul Pietrei the sands and clays with small mactras and congeria, the gritty limestone with *Mactra podolica*, the sands with cerits and the massive sands crop out, which will be further presented (Fig. 10).

The sands and clays with small mactras and congeria lie between the *Cryptomactra* clays and the gritty limestone with *Mactra podolica*. Jeanrenaud (1963, 1971) separated them into three units: I) clays and sandy clays (40–60 m); II) Bârnova sands (12–20 m) and III) clays and sandy clays (3–10 m). The upper boundary with the Repedea Limestone is clear, not only lithologically but also in respect of the fauna; instead, the lower boundary, with the *Cryptomactra* clays, is not specified.

The faunal content (mollusca and foraminifers) differs clearly from that in the base (fauna with *Cryptomactra*) as well as from the next one (fauna with *Mactra podolica, M. fabreana, Plicatiforma fittoni*, etc.). Jeanrenaud (1963, 1971) distinguishes two faunal groups: a) one indicating a much lower salinity (*Mactra macarovici*, ostracods, hydrobia, rare *Solen subfragilis* specimens) than that of the Bassarabian, present in all three lithological levels and b) another fresh water assemblage ("fauna with congeria") which, beside *Congeria (C. neumayri, C. politioanei, C. elongata*, etc.), often comprises also *Anodonta, Unio, Melanopsis, Theodoxus* and *Hydrobia*. Numerous specimens of *Hydrobia* even form thin centimetric, rarely decimetric intercalations.

More recent investigations (Ionesi, Cochior, 1993) show that mactras (*M. macarovici* inclusively) are to be found together with *Congeria, Melanopsis, Viviparus, Theodoxus*, etc., while the fresh water fauna (*Anodonta, Unio, Hydrobia*, etc.) occurs separately over a few meters thick interval. These faunas are accompanied also by terrestrial elements (*Helix, Hipparion*).

On Pârâul Pietrei the upper part of the clays (10 m), which contain exclusively fresh water fauna, and the Bârnova sands with brackish fauna (small mactras, congeria, etc.) can be seen.

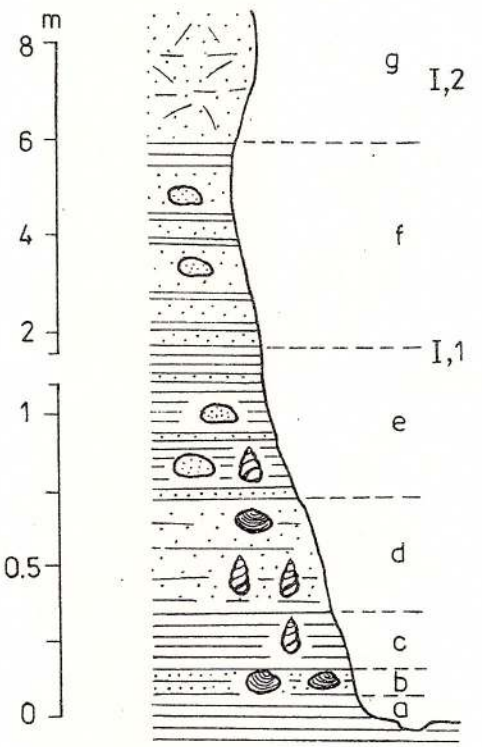

Fig. 11 – Details in clays and sandy clays with fresh-water fauna (I_1).

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Due to slidings, the relationships between the clays and the sandy clays with fresh water fauna on the one hand and the subjacent deposits on the other, are not evident. The succession begins with clays comprising fresh water fauna (Fig. 11) as follows:

a) 10 cm of non-fossiliferous bluish clays.

b) 4–10 cm of sandy clays with fresh water fauna. Macrofauna is represented by numerous bivalves and gastropods such as: *Anodonta şoldăneştiensis, Unio pictorum, Hydrobia elongata, H. moesiacensis, H. stagnalis, H. ventrosa, Pseudamnicola producta unicarinata, P. sarmatica, P.tholosa, Valvata soceni wiesenensis, V. politioanei, Neritina constantiae, N. bohotinensis, Theodoxus* cf. *rumanus* together with: *Cyprideis tuberculata, C. maxima, C. carbonneli, Cyprideis* sp., all of them having thin shell.

c) 20 cm of bluish siltic clays, with rare fragments of molluscs with undeterminable thin shells, among which also *Hydrobia* and *Valvata* are present. Microfauna comprises the same ostracods species.

d) 40 cm of fossiliferous, yellowish-greyish argillaceous sand with: *Anodonta, Valvata, Pseudamnicola, Hydrobia* and ostracods.

e) 1.8 m of bluish clays with thin siltstones intercalations, rarely sandy siltstones with rare specimens of *Valvata* and *Pseudamnicola* and numerous ostracods (the same species).

f) 4 m of bluish sands alternating with argillaceous sands, siltstones and clays, more frequent in the upper part. The only fossil remains are ostracods which are numerous and with very thin shell. These are overlain by massive Bârnova sands.

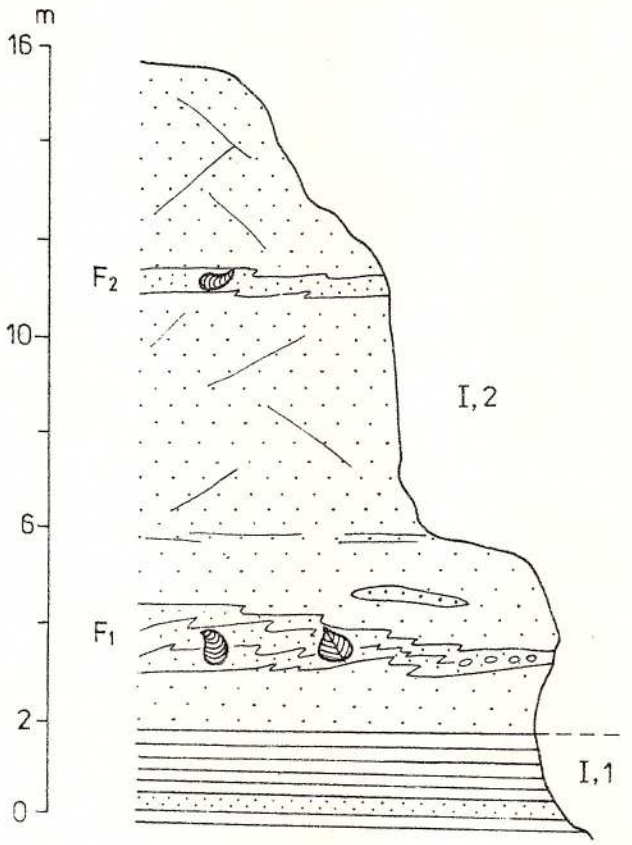

Fig. 12 – Details in Barnova sands (I_2): F_1 and F_2 fossiliferous levels with small mactras and congerias.

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The Bârnova sands represent the next formation, which is about 18–20 m thick, being exposed in the banks of Pârâul Pietrei. They are fine or medium-grained quartz-feldspathic sands with crossed bedding, forming thick banks or thin layers, separated by siltstone or clay interbeds. These sands comprise levels of gritty quartzose intergrowths, clay pebbles and microconglomerate lenses with sand and clay lithoclasts. Some thin iron oxide beds are also frequent. The quartz grains (85 %) are smooth or rugose, with rounded edges and corners, covered by ferruginous films.

Two lenticular fossiliferous levels occur in the left bank of Pârâul Pietrei, which are not to be found in the right bank. The first level, at 3 m from the boundary with the clays, ranges between 2–10 cm in thickness; it comprises also a conglomerate with sandstones and clays in the median part. The second level, at 3 m above the first one, is 30 cm thick (Fig. 12). The fossil remains are abundant but due to their fragility are rarely entire. They comprise: *Mactra macarovici, M. podolica, M. naviculata, M. caspia, Congeria mediocarinata, C. neumayri poenensis, C.* cf. *tacutai, C. soceni, C. ringeiseni, C. moldavica, Hydrobia* sp.div., *Melanopsis bouei affinis, M. andrusovi, M.* aff. *acicularis, Neritina bohotinensis, Viviparus* sp., *Valvata* sp., *Planorbis* sp., *Lymnaea* sp., *Helix* sp. as well as other fragments of the vertebrate skeletons (Ionesi, Cochior, 1993).

Bird bones (David, 1922) and a *Hipparion sarmaticus* molar (Cochior, Nechita, 1993) are also known.

The Bârnova sands are also poor in foraminifers and rich in ostracods such as: *Porosononion subgranosus, Nonion* sp., *Elphidium macellum, El. rugosum, Ammonia beccarii, Quinqueloculina* sp., *Globigerina, Globorotalia, Nodosaria, Bulimina.* The tests, eroded, polished and often fragmented, indicate reworkings. Ostracods, although having thin and fragile valves, are well preserved (*Cyprideis pannonica, C. mehesi, Iliocypris gibba* and *Erpetocypris recta*).

The bluish clays and sandy clays end the succesion with small mactras and congeria. They are about 4–5 m thick on Pârâul Pietrei. Among them red-brick-red or greenish bands can be noticed in places, which would suggest intense alterations of the continental source providing material. Jeanrenaud (1963, 1971) mentions a fresh water fauna in some other places, too.

The age of the deposits with small mactras, congeria and fresh water fauna intercalations cannot be established based on the fauna characteristic of these deposits but only taking into consideration the fauna of the adjacent deposits – *Cryptomactra* clays and the Repedea Limestone with *Plicatiforma fittoni, Mactra fabreana* etc. The assemblage within the clays with *Cryptomactra* (Văscăuţeanu, 1929) (*Plicatiforma fittoni, Mactra fabreana, Barbotella,* etc.) indicates that the upper part belongs to the Upper Bassarabian. Therefore the described deposits are included also in this interval.

The deposits with small mactras and congeria reflect important modifications in respect of the precedent formations: decrease in salinity, even fresh water episodes, arenitic sedimentation (Bârnova sands), the appearance of a neighbouring land (the fauna with *Hipparion sarmaticum*).

Eberzin (1958) supposes that the modifications would be due either to a regression of the brackish waters from the Galitian Gulf or to the insolation of a portion of the Sarmatic Basin through the occurrence of a barrier (North Dobrogea-Crimeea) which led to a decrease in salinity. The separation hypothesis seems plausible and in our opinion, it is due to a geodynamic uplifting process that led to the occurrence of the barrier, the transformation into land of the northern part of the Moldavian Platform (north of the Iaşi-Roman lineament) and the outlining of a gulf in which the deacrease in salinity took place, determining the occurrence

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of a fauna with small mactras and congeria. Fresh water faunas with *Anodonta* occurred in the marginal lagoons or even on temporary islands (on which some lakes also had existed). The prevailingly arenitic deposits (Bârnova sands) accumulated in the littoral-neritic zone in the vicinity of the mainland.

As it has already been shown, the small mactras are to be found together with the *Congeria, Melanopsis, Viviparus*, etc. The fauna is undoubtedly contemporaneous and indicates a decrease in salinity, which became similar to that from the Chersonian (considering the presence of the small mactras) or even lower (taking into account the identification of the species of *Congeria, Melanopsis, Viviparus*). The lack of this from the Chersonian indicates that they could not cohabit. The genera *Hydrobia, Neritina* and *Pseudamnicola* are highly adaptable so that they can be found in both cases. One should rather suppose that under the conditions of a similar salinity to that from the Chersonian there existed also some areas of low salinity, corresponding to the fauna with *Congeria, Melanopsis, Viviparus*. The decrease in salinity took place in some lagoons and lakes (separated by spits) or in the discharge zone of some rivers. In this situation the "fauna mixture" is mechanical, being due to the water currents and waves. Such cases are to be found now on the Black Sea shelf.

The gritty limestone with *Mactra podolica* (Repedea gritty-limestone) is well exposed on Pârâul Pietrei, being 5 m thick. Lithologically they consist of quartz sandstones (> 75 % quartz), quartz-lithic sandstones, oolitic limestones (oösparites), biosparites and less than 30 cm thick sand banks; there are transition portions among these banks, sandstones prevaling. Oösparites and biosparites appear as non-uniform intercalations separated by sands. There are parallel, oblique and cross-bedding. The succession begins with a sandy clay (0.6 m) in which *Musculus* is abundant.

The fauna is rich and comprises: *Ammonia beccarii, Porosonion subgranosus, Quinqueloculina akneriana, Q. consobrina plana, Mactra podolica, M. fabreana, M. naviculata, M. vasluiensis, Plicatiforma fittoni, P. plicatofittoni, Obsoletiforma obsoleta, Musculus sarmaticus, M. marginatus, Solen subfragilis, Tapes gregarius, Terebralia lignitarum, Potamides disjunctus, P. moldavicum, P. nefaris, Barbotella intermedia* etc. (Ionesi et al., 1984). The assemblage belongs to the biozone with *Plicatiforma fittoni* and *Mactra fabreana* or to the biozone with *Ammonia beccarii*and milliolids.

Paleogeographically the fauna points to the resettling of the brackish waters.

The sands and clays with cerits are to be found in the right bank of Pârâul Pietrei, overlying the gritty limestone with *Mactra podolica*, followed by 1.5 m of argillaceous sands (0.5 m) with numerous cerits and then by slightly fossiliferous bluish clays, siltstones and sands (< 1 m). The fauna comprises: *Potamides disjunctus disjunctus, P. disjunctus conicus, P. nefaris, Mactra podolica, Musculus sarmaticus, Elphidium macellum, El. subumbilicatum, El. listeri, El. mironovi, Ammonia beccarii.* The foraminifers are to be found especially in sands, which we consider an equivalent of the Scheia sandstones.

Massive sands with calcareous concretions. The deposits with cerits are overlain by fine quartzose sands exhibiting cross-bedding, exposed on a 6–7 m thickness. Beside the sandstones pieces from the base, they include also clay pebbles and rare gritty intergrowths. We found *Unio* and *Planorbis* and *Helix* fragments in these sands. There are also ostracods, *Chara* fructifications and rare reworked foraminiferal specimens.

Jeanrenaud (1971) assigns these sands to the Scheia ones (which contain very rich brackish fauna). We consider them equivalent to the sands and clays with *Helix* and *Planorbis* (= upper

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horizon of the Bassarabian, according to Jeanrenaud, 1971) and assign them to the deltaic Chersonian. They overlie unconformably either the sands with cerits or the gritty limestone with *Mactra podolica* (they will be further discussed at Bohotin).

Stop 3 – **The Bohotin Sandstones and Sands, Upper Bassarabian**
(*Bica Ionesi, Liviu Ionesi*)

The Bohotin locality is crossed by the Moşna-Grozeşti country road, separated from the Iaşi-Huşi highway at a distance of 4 km from Răducăneni. The section to be visited is situated on the northern slope of the Moşna Hill (234.9 m) in a place named "Pietrişu", at about 800 m from the Iaşi-Huşi highway.

The Bohotin locality is famous for its production of red wine, called "Busuioaca de Bohotin", which is unique in this country.

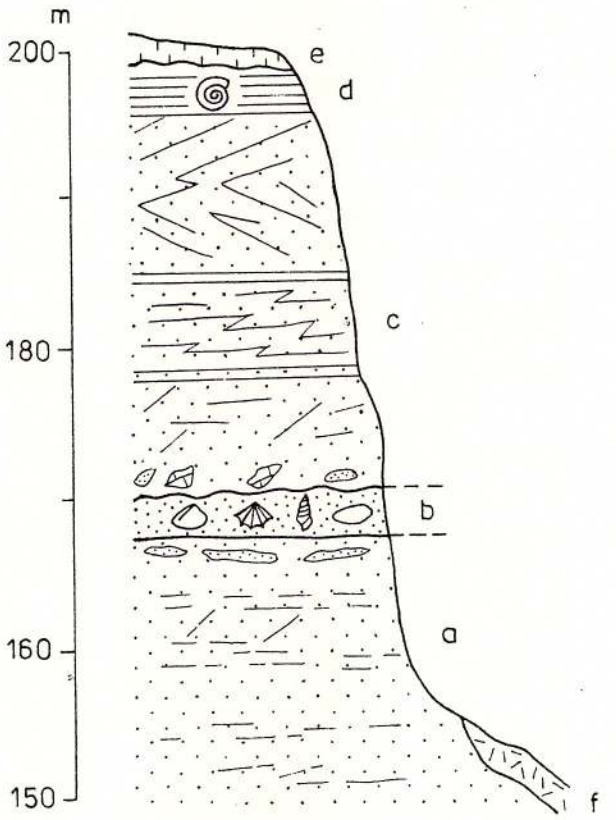

Fig. 13 – "Pietrişu Bohotin" outcrop: a, Bârnova sand; b, Bohotin gritty-sand with mixture fauna; c, massive sands; d, clays with *Planorbis* and *Helix*; e, soil; f, slope deposits.

The hills in the Bohotin region are formed (as at Răducăneni) of Bassarabian, Chersonian and Meotian deposits. In the place called "Pietrişu" the upper part of the sands and clays with small mactras and congeria, the Bârnova sands, the sandstones and the Bohotin clays respectively crop out, being considered a lithological variation of the gritty-limestone with *Mactra podolica*. The Răducăneni clays do not crop out. The massive sands which here contain clays with fresh water fauna in their upper part (Fig. 13), are assigned to the Chersonian.

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This place is characterized by its fauna which comprises, besides numerous brackish species, also fresh water species.

This outcrop includes only the upper part of the Bârnova sands that reach 8 m in thickness.

As compared to the deposits at Răducăneni, finer interbeds, siltstones and clays, occur; the last 3 m are marked by the prevalence of sands in which sandstone plates are to be found.

The fauna is poor, being present only in the last 3 cm, in three centimetric fossiliferous beds; rare *Hydrobia* specimens and *Mactra* fragments are also present. One should mention the foraminifers *Ammonia beccarii, Nonion* cf. *laevis, Nodosaria* sp. and *Globigerina* sp., considered to be reworked, numerous ostracods in the terminal part of the sands as well as *Chara* oogons.

A molar of *Hipparion sarmaticum* (Cochior, Nechita, 1993) was found in the base of the outcrop. As a matter of fact, east of the Prut (in Bessarabia) the vertebrate fauna (encountered in the deposits with congeria) is rich and varied, containing *Deinotherium* aff. *gigantea, Crocuta* sp., *Lagomeryx flerovi, Palaeotragus expectans* (Lungu, 1974), thus proving the existence of a mainland to the north of the sedimentations basin, where, under the littoral-neritic conditions, small mactras and congeria accumulated.

The Bohotin sands, extremely rich in fossils, overlie the Bârnova sands. These deposits form a 3 m thick outcrop, comprising sands and fossiliferous, weakly cemented sandstones. The abundance of fossils makes up weakly cemented lumachelles, sometimes even faluns. Oblique lamination is frequent. The cimentation tendency is more obvious in the upper part.

The fauna is abundant and comprises especially foraminifers, ostracods and gastropods as well as rare specimens of bryozoans and tubicle worms. Brackish, fresh water and terrestrial elements are discussed. The brackish fauna prevails, of which over 35 taxa are known such as: *Mactra fabreana, M. podolica podolica, M. podolica cobălcescui, M. podolica ovata, M. podolica moldavica, M. tapesoides, Plicatiforma fittoni, P. tzankovi, Obsoletiforma obsoleta, Tapes gregarius, T. vasluiensis, Musculus sarmaticus, M. moldavicus, Solen subfragilis, Donax lucidus, Potamides disjunctus, P. disjunctus conicus, P. nefaris, P. moldavicus, P. striatus, Cerithium* cf. *cantemiri, Terebralia lignitarum, Barbotella intermedia, Gibbula beaumonti, Gibbula rollandiana, Dorsanum ignobile, D. corbianum, D. duplicatum, D. omnivagum, Hydrobia* sp. div., etc.

A high frequency have shown *Mactra fabreana, Plicatiforma fittoni, Musculus sarmaticus, Solen subfragilis, Tapes vasluiensis*, cerits, *Barbotella intermedia, Dorsanum ignobile* and hydrobias which form even a lumachelle.

The foraminifers encountered are: nonionids (*Porosononion subgranosus subgranosus, P. subgranosus umboelata, P. martkobi*), elphiids (*Elphidium macellum, El. rugosum, El. aculeatum*, etc.), *Ammonia beccarii* and milliolids (*Quinqueloculina akneriana*, etc.). The ostracods are present in a smaller number.

The mollusca showing a still lower, almost fresh water, salinity are as follows: *Congeria panticapea, C. neumayri poenensis, Melanopsis andrusovi, M. fuchsi, M. bouei bouei, M. bouei affinis, Neritina bohotinensis, Theodoxus crenelatus basarabicus, Th. licherdopoli scriptus, Planorbis* sp., *Unio* cf. *moldavicus, Unio* sp., *Hydrobia* sp. div.

The terrestrial fauna is represented by the species: *Helix* cf. *subpulchella, Helix* sp., *Cepaea* sp.

The sandstones, sands and the Bohotin lumachelle represent a lithological variation of the gritty-limestone with *Mactra podolica*. This variation is a result of the fauna similarity, which contains age characteristic species such as: *Mactra fabreana, M. naviculata, Plicatiforma*

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fittoni, Gibbula beaumonti, Barbotella intermedia, Potamides nefaris, P. moldavicum. Another argument for this correlation is the stratigraphic position between the Bârnova sands and the massive sands.

On the whole the fauna doubtless indicates the Upper Bassarabian age (biozone with *Plicatiforma fittoni* and *Mactra fabreana*).

The deposits with *Mactra podolica*, prevailingly calcareous in the Repedea Hill (with biosparites and oösparites), gritty on Pârâul Pietrei (Răducăneni) and sandy with the agglomerations, the lumachellic faluns at Bohotin, point to the recurring of the brackish waters (faunal abundance) by a great exchange of living forms throughout the "Sarmatic Basin" (Dacic and Euxinic). Sedimentation remained neritic-littoral. The Bohotin region constitutes an exception by its lithology (however, fossiliferous sands are to be found at Repedea) and especially by the presence of the fresh water or very low salinity fauna, which likely originates from another biotope. This fauna probably existed in an isolated sector delimited by a sand bar, like a small lake that preserved, however, its link with the rest of the basin. A similar view on the "mixture fauna" is supported by Jekelius (1944) for the situation at Soceni, and by Jeanrenaud (1963, 1971) for that at Bohotin. As regards *Unio*, probably new specimens, adapted to some slightly brackish waters are present, and not fresh water species.

The Bohotin sands and lumachelle accumulated in a littoral-neritic zone with sandy patch.

The massive sands and the sandy clays with fresh water fauna overlie the preceding deposits, cropping out through a 30 cm thickness. Unlike at Răducăneni, there are no sandy clays with cerits between the two lithological units.

Petrographically they belong to the category of quartzose, quartz-lithic and argillaceous sands. They are overlain by siltstone and clay interbeds. Some of these clay interbeds contain gypsum crystals. The bedding is oblique and crossed. They are white or yellowish but there are also reddish levels (due to the iron oxides). They include angular sandstone and, in places fossiliferous, oölitic limestone blocks (2–3 m) (with Bassarabian fauna) in the base. The last three meters of the outcrop consist of greyish clays and siltstones with sand intercalation.

The clays and siltstones at the top often contain *Planorbis* and rarely *Helix* and *Cepaea* specimens. The presence of *Planorbis* indicates fresh, still waters, *Helix* and *Cepaea* originate from the neighbouring land, and *Unio* has been pointed out by us also at Răducăneni. A few foraminifers (*Ammonia beccarii, Elphidium macellum, Porosononion subgranosus, Globigerina* sp., *Orbulina suturalis, Cibicides* sp.), considered to be reworked, have been also identified in the sand.

As we have already shown in connection with the Răducăneni outcrop, the respective deposits are equivalent to the sands and clays with *Helix* and *Planorbis* (upper biozone of the Bassarabian, according to Jeanrenaud, 1971). Their dating in this way has no paleontological support. Rather they belong to the Chersonian in deltaic facies (sensu Jeanrenaud, 1971). In our opinion, there was a short sedimentation break between the Bassarabian and the Chersonian, followed by paleontological changes and the resettling of an entirely different sedimentation, either in "deltaic" facies or in facies with small mactras (Jeanrenaud, 1971).

Stop 4 - Bassarabian from the Dealul "Repedea" Geological Reservation

(*Liviu Ionesi, Bica Ionesi*)

The Repedea Hill, situated 9 km south of the Iaşi city, represents the northern part of the Moldavian Central Plateau at the contact with the Jijia Plain (Moldavian Plain). Both of them

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are physico-geographic subunits of the Moldavian Plateau. The Moldavian Central Plateau is a well outlined morphological unit with up to 400–450 m high hills, which usually shows flat, large, structural surfaces corresponding to the Sarmatian limy-gritty levels. This is the case also of the Repedea plateau which reaches its maximal altitude (407 m) in the Păun Hill. The Jijia Plain (Moldavian Plain) extending northwards represents a morphological contrast, consisting of large hills, below 200–300 m in highness, on the clays with *Cryptomactra*. The morphological contrast between the Moldavian Central Plateau and the Jijia Plain is marked by an escarpment known as "Coasta Iaşilor", which provides outcrops in the Sarmatian deposits.

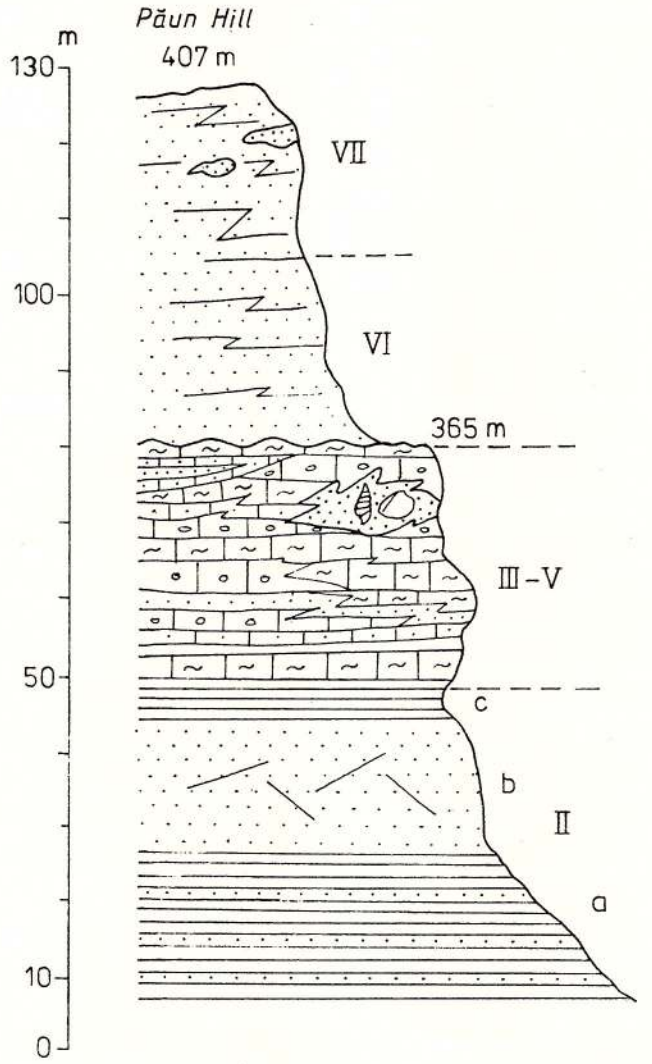

Fig. 14 – Synthetic lithostratigrafic column in the Repedea Hill-Păun.

Coasta Iaşilor, from the level of the Bahlui River (40 m) to the maximal altitude (407 m) on the Păun Hill, consists of deposits belonging to the Bassarabian and Chersonian. Thus the Bassarabian comprises: I) clays with *Cryptomactra*; II) sands and clays with small mactras and congeria (60–80 m); III) limestones and sandstones with *Mactra podolica* (> 5 m); IV) sands and clays with rare *Mactra podolica* specimens (< 10 m); V) the Scheia sandstones and sands

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(10–15 m). The Chersonian comprises: VI) clays and sands with *Helix* and *Unio* (30–40 m) as well as VII) the Păun sands (10–20 m) with vertebrate remains and plant imprints (Fig. 14).

The Repedea Hill has a special significance for the Romanian geology as it was the subject of the first geological paper, "The Limestone at Răpidea", written in Romanian by Grigore Cobălcescu, the first professor of geology from Romania, in 1862. Prof. Jeanrenaud (1971) also paid a special attention to these deposits.

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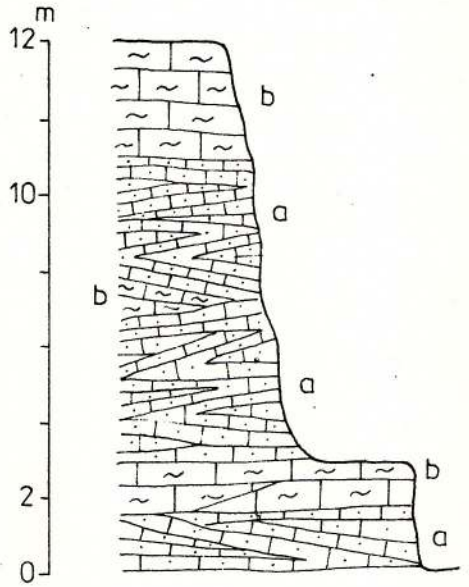

Fig. 15 – Lithologic details in the southern side of the big quarry in the Repedea Hill: a, calcareuos sandstones; gritty limestones and sands; b, biosparites with *Mactra podolica*.

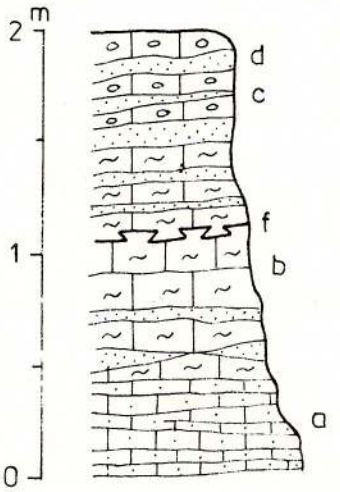

Fig. 16 – Lithologic details in the south-western part of the Repedea Hill: a, calcareous sandstones and gritty limestones; b, biosparites; c, oösparites; d, sands; f, ferruginous level (after I. Kalmar).

The limestones and sandstones with *Mactra podolica* reach 25 m in thickness. They overlie clays and siltstones (3–10 m), of which Jeanrenaud (1971) reports specimens of *Cardium* sp., *Mactra* sp., and *Musculus* sp. in a level situated under the limestones. The upper lithological unit (sands and clays with *Helix* and *Unio*) does not occur in the section presented. Lithologically it is worth mentioning the presence of oölitic limestones (oösparites), lumachellic limestones (biosparites) with *Mactra podolica*, sandstones and sands (Figs. 15, 16). Transiton rocks occur between limestones and sandstones.

The oölitic limestones (oösparites) constitute banks which laterally consist of sandstones or biosparites. The content in oölitic corpuscles may reach up to 90 %, in addition to which there are: allogenic and authigenic minerals, lithoclasts, pellets, and especially valves (whole or fragments) of mactras (especially *Mactra podolica*), cerits, cardiids, solen, foraminifers, ostracods. The cement consists of sparitic limestones. Oölites may be of precipitation or of algal accretion (Kalmar, 1991).

The lumachellic limestones (biosparites) consist almost exclusively of *Mactra podolica*, mostly molds. Micritic, calcareous or limonitic crusts (Fig. 16) often occur on the surface of bioclasts. Bioclasts are cemented through sparitic limestone.

The sandstones are to be found as thin strata consisting of allogenic minerals (quartz > 40 %, feldspars, muscovite, zircon, hornblende, etc.), lithoclasts (granites, gneisses, quartzites,

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sandstones, limestones), oölitic corpuscles, authigenic minerals (glauconite, iron oxides), bioclasts (whole or fragments), argillaceous minerals (kaolinite, illite). The cement consists of sparitic limestone. By the nature of their components, the sandstones are limy with gradings to gritty limestones.

The sands, which separate the sandstone and limestone beds, are similar to sandstones in composition. A sand lens reaching 6 m in thickness and a few meters in length, very fossiliferous in the upper part, occurrs in the south-western margin of the quarry.

The material from which the presented rocks originated is both of epiclastic (allogenic minerals and lithoclasts) and precipitation (oölitic, bioclasts) origin. These deposits accumulated in the neritic littoral zone of small depth, with a high water dynamics and therefore with a good aeration, which allowed the remarkable abundance of mactras. The epiclastic material originated from the emerged patches. It can be assumed that the environment had a reduced alcaline reserve (Kalmar, 1991), which determined the precipitation of oölites through algal accretion.

The fossil fauna in the Repedea Hill includes: foraminifers, ostracods, bivalves, gastropods, and mammals. Here, Cobălcescu (1862) mentioned for first time cardiids, *Solen* "cyrene" (=mactras), "venerids" (=*Tapes*), cerits (=trohids), and stressed out their brackish character. Simionescu (1903) specified the Bassarabian age of the respective deposits.

This is the place of the neotype of the species *Mactra podolica* EICHW. (the holotype is lost), whose variability is also studied, as well as the type place of other taxa. The deposit represents a biostratigraphic marker of the Upper Bassarabian.

Foraminifers. Their study began later on and it is due to Macarovici et al. (1956); it was continued and studied thoroughly by Paghida-Trelea (1969), Ionesi and Sioustis (1992). From this place are known: 40 taxa – *Ammonia beccarii, A. tepida* – miliolids (*Triloculina pseudoinflata, T. ukrainica sarmatica, T. neocircularis, T. zuewi, Quinqueloculina sinzovi, Q. akneriana akneriana, Q. akneriana rotunda, Q. consobrina sarmatica, Q.* cf. *voloshinovae ukrainica, Q.* cf. *moljawkovi*, etc.), *Elphidium macellum, El. subumbilicatum, El. minutum, Porosononion subgranosus, P. martkobi*, etc., as well as some reworked species of *Globigerina, Cibicides, Sphaeroidina, Asterigerina, Cornuspira.*

Among the known species, *Ammonia beccarii, Triloculina pseudoinflata, T. ukrainica sarmatica, T. neocircularia, T. zuewi, Quinqueloculina sinzovi, Q. akneriana akneriana*, and *Elphidium macellum* are species with a great and moderate frequency.

As regards the biostratigraphic significance, Ionesi and Sioustis (1992) considered the following species typical of the Upper Bassarabian: *Triloculina pseudoinflata, T. neocircularis, T. ukrainica sarmatica, T. zuewi, Quinqueloculina voloshinovae ukrainica, Q. moljawkovi, Q. sinzovi.* All these species are considered to belong to the biozone with *Ammonia beccarii*, to which milliolids (*Triloculina ukrainica sarmatica*) are added (Paghida-Trelea, 1969).

Ostracods. Only three species have been stressed out: *Leptocythere mironovi, Aurila kolesnikovi* and *A. sarmatica* (Trelea et al., 1970), which have no biostratigraphic significance (Ionesi, Chintăuan, 1994).

Bivalves are aboundant. As a result of the reviews made by Ionesi and Damian (1981) 28 taxa with well-preserved shells are known.

Mactras are dominated by *Mactra podolica*, with several subspecies – *Mactra podolica moldavica, M. podolica podolica, M. podolica cobălcescui, M. podolica ovata, M. podolica vasluiensis, M. podolica naviculata* – Ionesi et al., 1986), *Mactra fabreana* and *M.* cf. *subcaspia* being

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more rarely found. Species like *fabreana, naviculata* and *vasluiensis* have biostratigraphic significance only for the Upper Bassarabian.

Among cardiids, the following species have been identified: *Plicatiforma fittoni* (typical of the Upper Bassarabian), *Obsoletiforma jassoense, Ob. obsoletum, Ob. ingratum firma, Ob. cobălcescui*, etc.

Other bivalves are represented by: *Solen subfragilis, Donax dentiger, D. lucidus, Musculus sarmaticus, M. marginatus, M. moldavicus, M. naviculoides, Modiolus incrassatus elongatus, Pholas hommairei, Tapes gregarius, T. vitalianus, T. vasluiensis.*

The bivalves assemblage constitutes the biozone with *Plicatiforma fittoni* and *Mactra fabreana.*

Gastropods. There are 22 taxa dominated by cerits (*Potamides disjunctus disjunctus, P. disjunctus conicus, P. nefaris, P. moldavicum, P. striatum, Terebralia lignitarum*) followed, in the order of their frequency , by *Gibbula beaumonti, G. striatosulcata, G. athanasiui, Dorsanum duplicatum, D. pauli, Acteocina lajonkaireana, Hydrobia ventrosa, H. frauenfeldi, Psedamnicola sarmatica, Neritica bohotinensis.* This assemblage is assigned to the biozone with *Gibbula beaumonti, Barbotella* and *Potamides moldavicum.*

Mammals. From the gritty-limestone with *Mactra podolica* at Repedea, Macarovici and Paghida (1966) described two premolars (Pm^2 right and Pm^4 left) of *Aceratherium incissivum.* In the same formation at Scheia (20 km south-west of Repedea), Lungu et al. (1993) mentioned a molar of *Hipparion sarmaticum.*

In conclusion, the fossil fauna of the Repedea Hill indicates the upper part of the Upper Bassarabian characterized by *Mactra fabreana, M. podolica naviculata, M. podolica vasluiensis, Plicatiforma fittoni, Pholas hommairei, Gibbula beaumonti, Potamides nefaris, P. moldavicum, Triloculina ukrainica sarmatica, T. pseudoinflata, T. neocircularis, Quinqueloculina sinzovi, Q. voloshinovae ukrainica*, etc.

Stop 5 – Upper Bassarabian in the Băiceni Sector (Moldavian Platform)

(*Natalia Trelea, Petru Stefan*)

The Băiceni sector is situated in the central zone of the Moldavian Platform.

The first geographic reference to the zone north of Tg. Frumos was made by Cobălcescu (1883), then by Atanasiu (1945), Atanasiu and Macarovici (1950), Macarovici and Turculeţ (1956).

In the Băiceni zone the Bassarabian deposits are cropping out in the Băiceni Brook and its tributaries as well as on the slopes of the surrounding hills (Laiu, Tinosu, Dealul lui Mihai). In this area the Bassarabian is represented only by its lower part.

Following the lithologic succession of the Lower Bassarabian deposits as well as their areal development within the context of their spreading in the geostructural units to which they belong, in the Băiceni zone several deposits have been separated as members of the *Cryptomactra* formation (Fig. 17):

a) *Băiceni clays and sands* represent the first lithologic member (Ştefan, 1989) of the Lower Bassarabian pelitic deposits and they conformably lie over the Volhynian terranes. Lithologically, they are bluish marly clays with slightly sandy intercalations passing to argillaceous sands towards the upper part. The base of the member is concealed, being below the erosion

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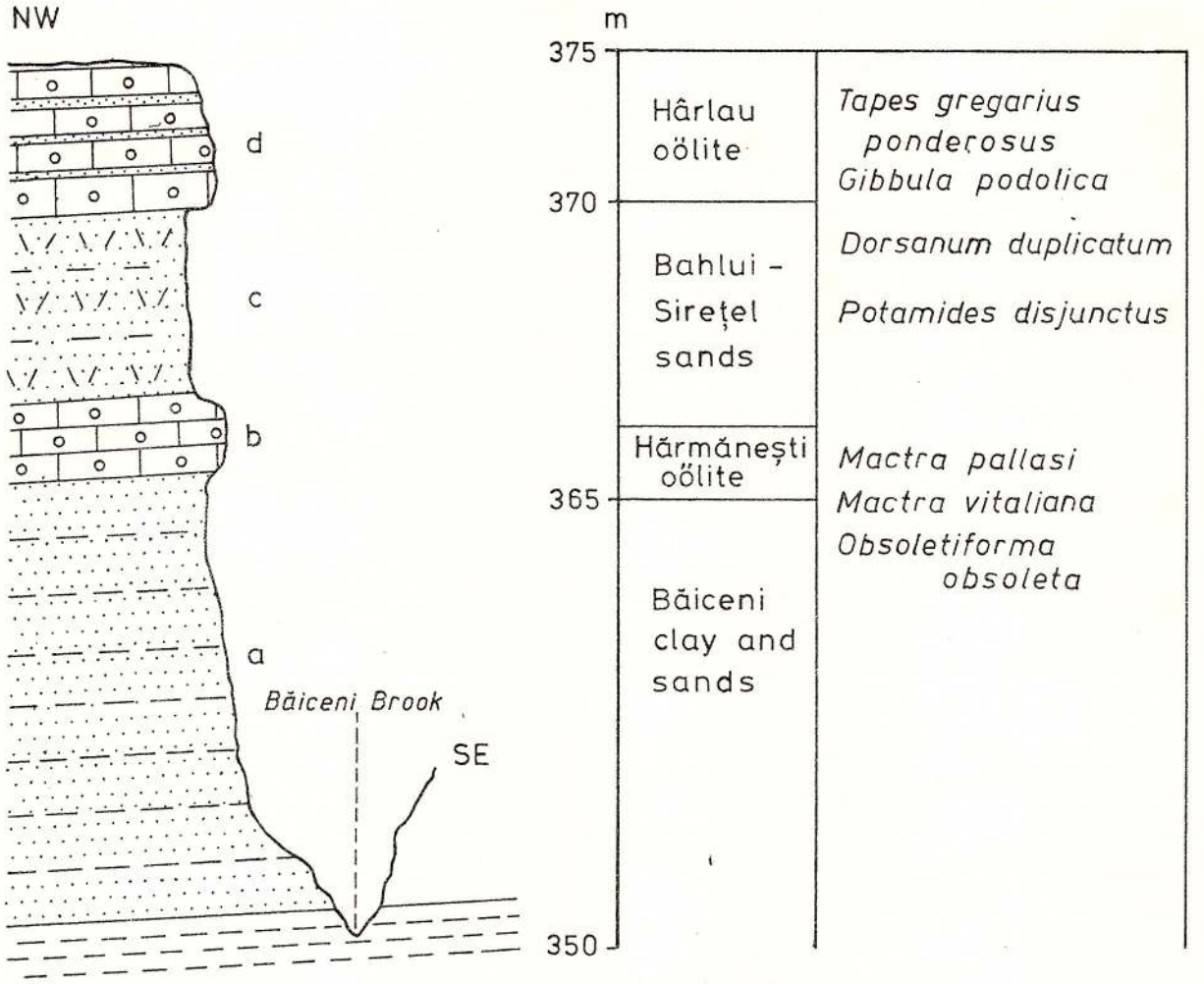

Fig. 17 – Geological section through the Lower Bassarabian formations of the Băiceni area.

level.

b) *Hărmăneşti oölite.* The Băiceni clays and sands are overlain by a first intercalation of oölitic limestones known as "Hărmăneşti oölite" (Macarovici, Turculeţ, 1956). Later on, this name was used by Ştefan (1989) only for the first oölite level.

Generally, the thickness of this lithologic member is of about 4–5 m; in petrographic respect, oölitic limestones occur as plates with thicknesses varying from some centimetres to 30–40 cm, with a high content of bioclasts.

c) *Bahlui-Şireţel sands* lie over the Hărmăneşti oölite; they are about 6–8 m thick and are represented by quartz-lithic sands, with a pseudo-oölitic aspect. Their denomination was introduced by Ştefan (1989) after the name of the place where the best outcrops are found. They frequently show a cross bedding.

d) *Hârlău oölite* is about 3–4 m thick and is widely spread in the Băiceni zone (the second

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level of oölitic limestones). Its name was given by Ştefan (1989) in order to avoid any confusion with the Hărmăneşti oölitic bank (Macarovici, Turculeţ, 1958) which occurs at the lower part.

Petrographically it occurs as oölitic sandstones in plates and banks, of about 0.4–0.5 m thick, with millimetric intercalations of oölitic sands.

The Lower Bassarabian formations which crop out in the Băiceni zone, especially in oölites, contain a rich molluscan fauna, accumulated as lumachelles, with whole shells. This fauna is represented by *Mactra vitaliana* D'ORB., *M. pallasi* BAILY, *Tapes gregarius ponderosus* D'ORB., *T. vitalianus* D'ORB., *Dorsanum dissitum* DUB., *D. duplicatum* SOW., *Gibbula podolica* KOL., *Plicatiforma planicostata* (AL. et MAC.), *Obsoletiforma obsoleta* (EICHW.), *Donax lucidus* EICHW., *Potamides disjunctus* (SOW.). The genera *Gibbula, Dorsanum, Tapes,* and *Mactra* and *Potamides* are abounding in the Hârlău oölite.

The microfaunal assemblages in the Băiceni zone are quite similar with those in the Pietrişu-Ruginoasa zone. The richest fauna occurs in the lower member (Băiceni clays and sands) and is characterized by the prevalence of elphids (*Elphidium, Parrelina, Retroelphidium, Saidovelly*) and nonionids (particularly *Porosononion*). Genera *Ammonia (A. beccarii* L.) and *A. tepida* (CUSHMAN) are found as well. All the foraminiferal remains are well preserved and occur quite frequently.

In the argillaceous intercalation the sizes and the frequency of the foraminifers decrease, the assemblage abounding in milliolids, articulines; elphids and nonionids are quite rare.

The fauna remains indicate the Lower Bassarabian, namely the biozone with *Mactra pallasi* and *Tapes gregarius ponderosus*, beside *Gibbula podolica.*

Stop 6 – **Volhynian Terranes with Ervillia at Burdujeni-Suceava**
(*Bica Ionesi, Viorel Ionesi*)

The outcrop occurs in the Burdujeni district, in the northern part of the Suceava town. One can reach it through the Grigore Andrei Street; here, there is a plateau named La Oi Hill, developed on gritty-limestones with *Ervilia.* It ends to the west (towards the Bogdana Brook) abruptly, with exposures of gritty-limestones with *Ervilia.* These deposits, overlain by the terrace deposits of the Suceava River (100 m terrace), have been exploited, uncovering the calcareous-gritty plate. A piece of this terrace can be observed at 379 m height.

The Dragomirna Plateau as well as the whole northern sector of the Moldavian Platform, between the Siret and Moldova, develop on Lower Sarmatian deposits. They are mainly constituted of sands and clays with intercalations of sandstones and limestones (< 5 m); total thickness is of about 500 m. A detailed study of the lithology and fauna (bivalves, gastropods, foraminifers and ostracods) made possible the establishing of the lithostratigraphic sequence, the age determination and the separation of biozones (Ionesi, 1968, 1980, 1991; Ionesi, Chintăuan , 1994).

The gritty-limestone of the La Oi Hill corresponds, according to Ionesi (1968), to the Pătrăuţi 2 gritty-limestone level. At about 50 m, this is overlain by the Burdujeni limestone-gritty level, considered a marker for the delimitation of the Lower Volhynian from the Upper Volhynian (Macarovici, Jeanrenaud, 1958; Ionesi, 1968). Up to this level (inclusive), on a thickness of about 200 m, the Volhynian deposits contain a fauna dominated by *Ervilia* which locally forms lumachelles (biosparites). Beside *Ervilia*, tapes (*Tapes tricuspis, T. vitalianus, T. naviculatus*) and cardiids (*Plicatiforma plicata plicata, Obsoletiforma lithopodolica, O. obsoleta, Mactra eichwaldi, Musculus naviculoides, Potamides mitralis*, etc.) are also found.

Above the Burdujeni level up to the Bassarabian boundary (the occurrence of the taxa

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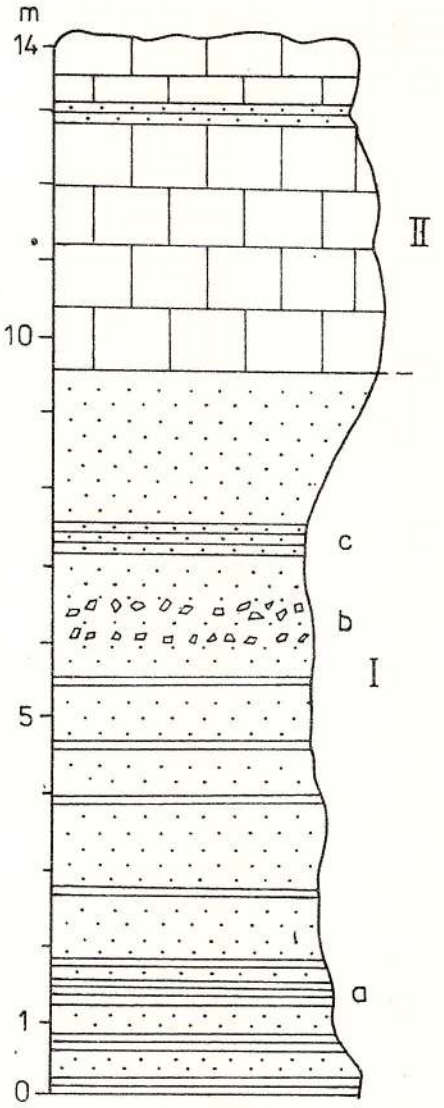

Fig. 18 – Profile in the western side of the La Oi Hill-Burdujeni. I, sands with fossiliferous levels (*Ervilia, Plicatiforma plicata, Tapes*, etc.): a, clays and siltites; b, levels with rock pebbles from the Carpathian flysch; c, sandstones as thin beds; II, sandstones and limestones with *Ervilia*.

Mactra pallasi, Tapes gregarius ponderosus) *Ervilia* is less frequently found (but it does not disappear) whereas cerits (*Potamides nimpha, P. mitralis*, etc.) and cardiids are abounding.

At the western margin of the plateau, in the La Oi Hill (left side of the Bogdana Brook), Volhynian deposits with *Ervilia* are found, which are represented by sands (I) and gritty-limestones (II), namely Pătrăuţi 2 level (Fig. 18). They continue with sands with intercalations of sandy clays and thin sandstone beds, overlain by the Suceava terrace deposits (100 m).

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I. *Sands.* Pătrăuţi 2 gritty-limestone overlies yellowish quartz-lithic sands with rare intercalations of clays, sandy clays (a) and platy sandstones (c). Two lenticular thin (< 10 cm) beds, which contain rolled pebbles coming from the Carpathian flysch deposits (b) are also observed.

II. *Sandstones and limestones with Ervilia (Pătrăuţi 2).* They are represented by sandstones, oösparites, biosparites, sands and especially transition rocks between them. Quartz-lithic and quartz-feldspathic sandstones, with calcitic cement, are prevailing. There are also passings to gritty-limestones and oölitic sandstones. In the upper part occur also thin sandstones beds with a siltic, clayey matrix, which can be easily altered, making possible the release of fossils.

The oölitic limestones with sparitic cement (oösparites) occur more rarely and usually they consist of a quite large amount of clastic material. Biosparites contain numerous *Ervilia* shells. Thin sand intercalations are found between the sandstones and limestones beds.

The surfaces of the beds are irregular, with a parallel or cross bedding. Frequent lithological variations are noticed, too.

Bivalves are rarely found in sands and they are abounding in gritty-limestones. The following bivalves have been recognized: *Ervilia podolica dissita, E. podolica concinna, E. trigonula, Tapes tricuspis, T. vitalianus, T. gregarius gregarius, T. gregarius dissitus, Plicatiforma plicata, Obsoletiforma lithopodolica, O.* cf. *vindobonensis, Mactra eichwaldi, Musculus sarmaticus, M. naviculoides, Donax dentiger.*

The Volhynian biozone with *Plicatiforma plicata, Mactra eichwaldi* and *Ervilia* is pointed out.

Gastropods are generally few, and are represented by: *Potamides mitralis, P.* cf. *pictus, P. nodosoplicatus, Gibulla* sp. div. (mulaja), *Acteocina lajonkaireana, Hydrobia elongata, H.stagnalis stagnalis, H. stagnalis andrusovi.*

Foraminifers are found both in sands and in gritty-limestones; they are represented by *Ammonia* and milliolids (with some large-size specimens), among which mention should be made of: *Ammonia beccarii, Quinqueloculina akneriana akneriana, Q. akneriana elongata, Q. consobrina consobrina, Q. consobrina sarmatica, Elphidium macellum, El. rugosum, El. minutum, El. subumbilicatum, El. aculeatum, El. listeri, El. alvarezianum, El. hauerinum, Porosonionion subgranosus, P. martkobi, Nonion bagdanowiczi* etc.

Many reworkings are found both in sands and in gritty-limestones.

Ostracods and otolits have been identified besides foraminifers.

In conclusion, the Pătrăuţi 2 gritty-limestone is of Volhynian age.

Stop 7 - Upper Volhynian in Arghira Zone (Muscalu Brook)

(*Bica Ionesi*)

Arghira locality is situated on the Şomuzul Mare Valley (right tributary of the Siret River), 12 km east of the town of Fălticeni (Suceava district). In the northern slope of the Arghira Hill (408 m), Muscalu Brook shows a very good outcrop in Volhynian deposits. Because of a bridge (over the Şomuzul Mare) which is being repaired, the distance (about 1.5 km) from the Fălticeni-Dolhasca highway to the outcrop has to be made on foot. The hills (about 528 m high), fragmented by the Şomuzul Mare and its tributaries, belong to the Fălticeni Plateau of the Moldavian Plateau. The general aspect is similar with that of the Central Moldavian Plateau.

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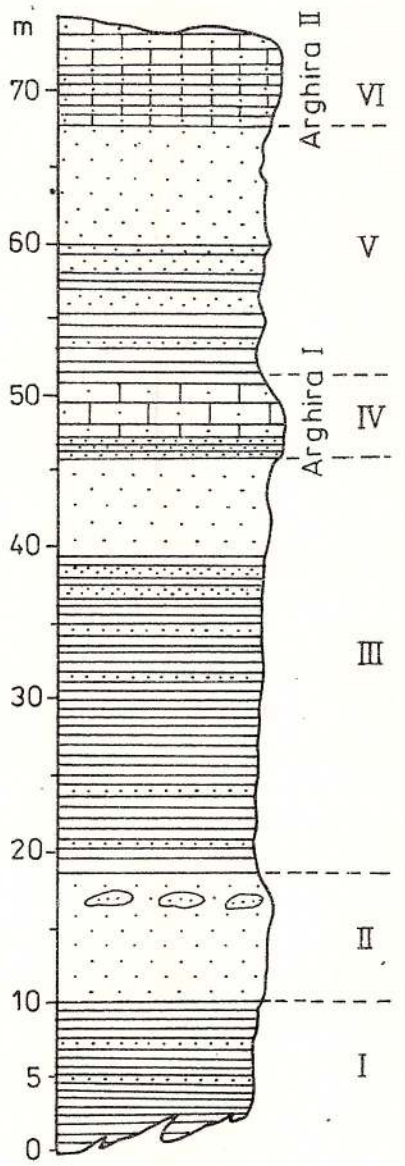

Fig. 19 – Synthetic litho- and biostratigraphic column of the Upper Volhynian in the Arghira zone.
I, clays with *Elphidium macellum, Ammonia beccarii, Leptocythere mironovi*, etc.; II, sands with *Porosononion subgranosus, Ammonia beccarii*, etc.; III, siltic clays and sands with *Potamides mitralis, P. nimpha, Tapes tricuspis, T. vitalianus, Plicatiforma plicata, Ervilia*, etc.; IV, Arghira I sandstones with *Mactra eichwaldi, Plicatiforma plicata, Tapes, Ervilia*, etc.; V, clays, siltstones, sands with *P. mitralis, El. macellum, P. subgranosus, L. mironovi*, etc.; VI, Arghira II sandstones with *Plicatiforma plicata, Mactra eichwaldi, Ervilia*, etc.

In several outcrops (Manolea, Nigoteşti, Tătăruşi) one can notice the passing from the Volhynian (*Plicatiforma plicata plicata, Mactra eichwaldi, Ervilia, Potamides mitralis*) to the

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Bassarabian (*Mactra pallasi* and *Tapes gregarius ponderosus*) (Ionesi, 1969, 1980). In the Fălticeni-Baia-Boroaia zone, the Volhynian deposits also include some lignite beds (< 0.8 m), which either lie directly on deposits with a brackish fauna or they are accompanied by a fresh-water fauna. This situation shows the existence of short uplifting stages , during which the peat bogs become swamps, locally succeeding directly the basement of the brackish deposits.

The Volhynian deposits occur in the northern slope of the Arghira Hill (408 m), on a thickness of ca. 75 m. The Volhynian deposits between the Siret Valley and Moldova Valley are of about 500 m thick. The Arghira deposits represent approximately the lower part of the upper half of the Volhynian.

The Volhynian in the Arghira Hill is represented by clays, siltstones, sands and argillaceous sands, within which two levels of calcareous sandstones – Arghira I and II (Ionesi, 1968) – have been individualized towards the upper part. In the lower part (30 m) clays and siltstones, with thin intercalations of sands, argillaceous sands and some coaly laminas, are prevailing. There is also a sand bank (8 m thick) with hard, quartzous sandstones concretions. Within the clays and sandy clays, which succeed the sand bank with concretions, high-fossiliferous beds with cerits, tapes, cardiids, etc., are frequently observed. The upper half is almost exclusively constituted of sands and sandstones, excepting a packet of clays (5 m thick) overlying the Arghira I sandstone level. The transition between the lower argillaceous half and the upper arenitic one is gradual (Fig. 19).

Arghira I gritty-limestone (4–5 m thick) consists in the base of calcareous sandstones as thin beds (< 5 cm), separated by sands followed by hard, compact, calcareous sandstones. Sandstones frequently contain fossils, in places abounding, becoming lumachelle limestones (biosparite).

Arghira II gritty-limestone is about 8 m thick and consists of centimetric and decimetric beds of calcareous sandstones, separated by fossiliferous sands (on the whole about 6 m), of which the last 2 m are formed of massive, poorly cemented sandstones, with gritty concretions. This level is less rich in fossils than the former one.

According to lithology and fauna, it results that the deposits accumulation took place in the neritic zone of an epicontinental sea. The sands deposition indicates shallower depths corresponding to a formation zone of the littoral belts and of molluscs abundance.

In the deposits exposed by the Muscalu Brook bivalves, gastropods, foraminifers and ostracods have been identified (Ionesi, 1968; Ionesi, Chintăuan, 1978). Bivalves and gastropods are quite numerous, starting with the clays which succeed the first sand bank, reaching the maximum of development in the Arghira I sandstones bank. In the sands and clays between the two sandstones banks and in the Arghira II sandstones, they are less frequently found.

In the clay-sandy deposits and in the Arghira I sandstones, tapes, mactras and cardiids are abounding; above the Arghira I bank the cardiids are prevailing. The other taxa (those with *Ervilia* inclusive) are more rarely found. More than 30 taxa have been found, among which mention should be made of: *Mactra eichwaldi, M. vitaliana, M. urupica, Plicatiforma plicata plicata, Pl. plicata kasinkense, Pl. latisulcata, Pl. plicatofittoni, Obsoletiforma obsoleta, O. vindobonensis, O. lithopodolica, O. ingrata, Tapes tricuspis, T. gregarius gregarius, T. gregarius dissitus, T. vitalianus, Ervilia podolica dissita, E. podolica cancinna, E. trigonula, Musculus naviculoides, Solen subfragilis, Donax dentiger*, etc. This assemblage clearly indicates the biozone with *Plicatiforma plicata, Mactra eichwaldi* and *Ervilia* (Ionesi, 1991).

Gastropods are abounding in the clay-sandy deposits below the Arghira I gritty level, being dominated by cerits and hydrobia, beside rare specimens of *Dorsanum* and *Gibbula*. Of

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more than 30 taxa, we mention: *Potamides nimpha, P. mitralis mitralis, P. mitralis tristriatus, P. bicostatus, P. pictus, P. disjunctus disjunctus, P. disjunctus conicus, P. quadricinctus* (=*friedbergi*), *P. bicinctus, P. nodosoplicatus, Hydrobia* div. sp., *Dorsanum duplicatum, D. corbianum, D. elegans, D. dissitus, Gibbula picta, G. rollandiana* etc.

In more than 1,900 specimens, *Potamides nimpha* represents 88 %, *P. mitralis mitralis* 9.7 %, *P. disjunctus disjunctus* 2.7 %, *P. pictus* 2.3 %, *P. bicostatus* 1.3 %, the other taxa representing less than 1 %. According to ornamentation some transition forms between the taxa have been separated: *nimpha, bicostatus, mitralis, pictus* and *bicinctus*, as well as between *disjunctus* and *quadricinctus*. The study of the population stressed out that some species and subspecies represent individual variation (e.g. *Potamides convexus* EICHW.= *Potamides disjunctus disjunctus* SOW., *P. mitralis nodosa* SIM. et BARBU=*P. mitralis mitralis* EICHW., *P. orheiense* SIM. et B.= *P. quadricinctus* SIEBER, etc). The whole assemblage corresponds to the biozone with *Potamides mitralis, P. nimpha* and *P. bicostatus* (Ionesi, 1991).

Foraminifers occur in the whole succession in the presented outcrop (Muscalu Brook), with small variations according to the lithofacies. Like the molluscs they become numerous above the first sand bank (8 m), and they are frequently found up to the Arghira II sandstones level. Genus *Elphidium* (25 taxa) is dominant, followed by *Porosononion* and *Ammonia*. Milliolids are less frequently found or quite rarely found: they do not occur in the Arghira I level.

Of the 40 taxa, mention should be made of: *Elphidium macellum, El. subumbilicatum, El. rugosum, El. strattoni, El. minutum, El. antoninum, El. ukrainicum, El. microelegans, El. subnodosus, El. sculpturatum, Porosononion subgranosus, P. martkobi, Nonion bogdanowiczi, Ammonia beccarii, Quinqueloculina consobrina consobrina, Q. consobrina nitens, Q. akneriana akneriana, Q. akneriana rotunda, Q. collaris*, etc. There are also reworked specimens, such as: *Subbotina triloculinoides, Globigerina officinalis, Globigerinoides trilobus, Gl. bisphaericus, Orbulina, Reussella, Bulimina, Virgulina, Eponides, Cibicides, Sphaeroidina*, etc.

The foraminiferal assemblage belongs to the biozone with *Elphidium rugosum, Quinqueloculina consobrina* and *Ammonia beccarii* (Ionesi, 1991).

In comparison with the foraminifers, the ostracods are less numerous, being found only in the clay-sandy deposits below and above the Arghira I sandstones level. The whole assemblage is constituted of 37 taxa, among which *Cyprideis heterostigma obesa, C. pannonica, C. punctilata, Leptocythere mironovi, L. cellula, Aurila punctata, Hemicytheria schreteri, Xestoleberis elongata, loxoconcha fragilis, L. rhomboidea obliquata*, etc. (Ionesi, Chintăuan, 1978).

The study of the evolution of the ostracods, from the Sarmatian of the Moldavian Platform, made possible the separation for the whole Volhynian of the biozone with *Leptocythere mironovi*, subdivided into 2 sub-biozones: a lower one with *Leptocythere bosqueti/Xestoleberis lutraea*, and an upper one with *Xestoleberis elongata*, which also includes the Arghira assemblage (Ionesi, Chintăuan, 1994).

Stop 8 - "Mixture Fauna" from the Văleni Sands

(*Liviu Ionesi, Bica Ionesi*)

The Văleni sands are well exposed in the area of the Mărgineni and Hoişeşti localities (Neamţ district), crossed by the Piatra Neamţ-Podoleni highway, situated at 21 km and 24 km, respectively, east of the Piatra Neamţ town.

The hills from this area (Temelia, Stanişte, Hârţeşti, Via Mărgineni), with a maximum height of 492 m (Via Mărgineni), belong to the "piedmont hills", in the western part of the

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Moldavian Plateau, near by the Subcarpathians (Carpathian Orogen). The piedmont character is given by the presence (in their constitution) of the Sarmatian rudites brought by paleorivers from the Carpathian Orogen and deposited in the discharge zone in the Sarmatian Sea (Mărtiniuc, 1956).

The Mărgineni-Hoişeşti area, situated in the western part of the Moldavian Platform (near by the peri-Carpathian fault), is constituted of mostly arenitic deposits, with rudite levels, belonging to the Bassarabian-Chersonian interval. Some deep drillings in the peri-Carpathian molasse or the Outer Carpathian Flysch (Tarcău and Vrancea nappes) penetrated their deposits and then intruded the Neogene deposits of the Moldavian Platform. Thus, the Cuejdiu borehole (north-west of Piatra Neamţ), situated in the Vrancea Nappe, 18 km west of the peri-Carpathian fault, entered the Neogene deposits at -4400 m deep. This position confirms the geodynamic movements in the Moldavian phase. Subsequent movements, but of a lower intensity, reactivated the peri-Carpathian fault, in certain sectors, generating the dipping of the Bassarabian deposits, near by the fault, such as at Serbeşti and Mărgineni (Fig. 20). The most recent platform deposits, covered by the Carpathian Orogen, do not exceed the Lower Volhynian.

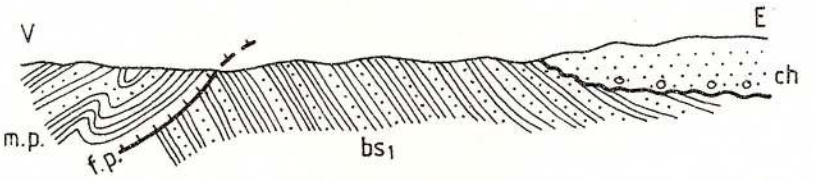

Fig. 20 – Geological section at the contact between the peri-Carpathian molasse and the Moldavian Platform (Mărgineanca Brook). p.m., peri-Carpathian molasse; p.f., peri-Carpathian fault; Bs., Bassarabian; Ch., Chersonian.

In the Văleni-Mărgineni-Hoişeşti region, within the Sarmatian deposits, a lithologic unit, mostly sandy, named "Văleni Sands" (Macarovici, 1954), has been separated. It consists of a Bassarabian-Chersonian "mixture fauna", which represents the object of our observations.

The Văleni sands are spread on a reduced area at the western margin of the Moldavian Platform, between the Valea Albă Brook (right tributary of the Moldova Valley) and the Bistriţa Valley. The maximum development is in the area of the localities of Mărgineni and Hoişeşti, in the Stanişte, Temelia, Hârţeşti, and Via Mărgineni hills. They lie over Bassarabian deposits (at Văleni and Mărgineni). In the left side of the Mărginenca Brook (Temeia Hill), the Văleni sands lie over an alternation of sands, clayey sands and clays, which contains a fauna with: *Tapes gregarius gregarius, T. gregarius ponderosus, T. vitalianus, Mactra vitaliana, Solen subfragilis, Gibbula hommairei* and *Dorsanum* sp., *Elphidium macellum macellum, El. macellum aculeatum, El. rugosum, Parrelina regina, Porosononion subgranosus.* This assemblage corresponds to the biozone with *Tapes gregarius ponderosus* and *Mactra pallasi*, typical of the Lower Bassarabian. It results that the Upper Bassarabian (biozone with *Plicatiforma fittoni* and *Mactra fabreana*) is lacking in this zone.

The Văleni sands are well exposed when leaving the locality of Hoişeşti toward Podoleni, in the northern side of the Hârţeşti Hill, even at the margin of the highway. The two outcrops (at

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600 m one from another) complete one another on the vertical, forming a succession of about 25 m thick. 10 m of sporadic outcrops on the Curmătura Brook are also added.

The fine- and medium-grained sand consists mostly of quartz grains beside which feldspars, garnets, rutile, hornblende, quartzite lithoclasts, clayey minerals, iron minerals, iron oxides are added. Consequently they are quartzous sands (quartz > 75 %), with thin intercalations of clays. Thin plates of sandstones, gritty concretions, levels of pebbles from Paleogene rocks are also observed. In other outcrops lenses of clays with Bassarabian fauna occur as well. At Văleni, in their lower part, pieces of sandstones and limestones, with the same type of fauna, are observed. They display a parallel- or cross-bedding.

The Văleni sands contain remains of molluscs, locally accumulated as lenses, as well as foraminifers and ostracods. Floral imprints are found in the clayey intercalations.

The bivalves and gastropods, belonging to the Bassarabian and Chersonian (Martiniuc, 1948; Macarovici, 1954, 1964; Ionesi, Ionesi, 1976), are of special significance.

The Bassarabian fauna is represented particularly by varied bivalves, such as: *Mactra vitaliana, M. pallasi, M. podolica, M. tapesoides, Tapes gregarius gregarius, T. gregarius ponderosus, T. gregarius dissitus, T. vitalianus, Plicatiforma plicatofittoni, Obsoletiforma obsoleta, O. kishinevense, Donax dentiger, D. lucidus, Musculus moldavicus, Solen subfragilis*, etc. It is of note the presence of species with large and thick shell (*Mactra vitaliana, M. pallasi, Tapes gregarius ponderosus*) and of those with thin shell (*Donax, Musculus, Solen, Plicatiforma plicatofittoni*). There are also markers of the Lower Bassarabian (*Mactra pallasi, Tapes gregarius ponderosus*).

The gastropods are rarely found and they are represented by: *Dorsanum corbianum tolerabile, D. omnivagum, Dorsanum* sp., *Gibbula* sp., *Acteocina lajoncaireana, Pseudamnicola sarmatica, Hydrobia* div. sp.

The foraminifers are rare and they include specimens with a well-developed test, e.g.: *Elphidium macellum, El. rugosum, El. fichtelianum, El. listeri, Porosononion subgranosus* (quite frequently found at this stratigraphic level).

The presence of the ostracods has been observed in the analysed samples, but they have not been determined.

The Chersonian fauna consists of numerous small-size mactras, among which we mention: *Mactra bulgarica bulgarica, M. bulgarica crassicolis, M. bulgarica elongata, M. orbiculata, M. orbiculata timida, M. supernaviculata, M. intermedia, M. rostrata, M. dobrogeana, M.* cf. *caspia*, etc. The small mactras represent 75-80 % of the total fauna, and they are very well preserved.

The problem is whether these two fauna types, which represent different paleocenoses, are or are not contemporaneous, the age being given by the Chersonian. In this respect, some authors considered this "mixture" a contemporaneous unitary fossil assemblage. There are different points of view only as regards the time location, that is at the beginning of the Chersonian (Martiniuc, 1948) or at the end of the Bassarabian (Macarovici, 1954, 1964). According to these authors the "fauna mixture" would represent the transition between these two intervals.

Ionesi and Ionesi (1976) consider that each of the two assemblages indicates a certain salinity type which excludes the possibility of their existence in a unique biocenosis. In our opinion it is hard to admit that the fauna with small mactras, quantitatively dominated by the number of the taxa, which characterizes the Chersonian, can be adapted to the salinity conditions from the Bassarabian; it is also unlikely the adaptation of the variation of the Bassarabian-type fauna to the Chersonian conditions. In case of a transition fauna it would have existed

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a selection and the possibility of sporadic occurrences of Chersonian species. Furthermore, the selection should have taken place at the level of the assemblage with *Mactra fabreana* and *Plicatiforma fittoni*, not at the level of the assemblage with *Mactra pallasi* and *Tapes gregarius ponderosus*.

In conclusion, we consider that the two fauna types could not coexist due to their entirely different life conditions. The small-size mactra assemblage succeeded the varied Bassarabian fauna, its occurrence being due to the strong decrease of salinity. Nowhere within the Paratethys a similar "mixture" of fauna has been observed in the Upper Bassarabian or in the Lower Chersonian. It is obvious that the "mixture" has other source.

In our opinion, the Bassarabian species (bivalves, gastropods and foraminifers) from the Văleni sands are autochthonous, their presence being the result of resedimentations. It results that between the Bassarabian and the Chersonian there was a short interruption of sedimentation in the foreland of the Romanian Carpathians, the Moldavian Platform inclusive, as a result of some geodynamic processes of uplifting. In fact, the Chersonian deposits display a regressive character (as against the Bassarabian); in this situation submarine slidings took place in a first phase with the resumption in sedimentation of Bassarabian deposits. Under conditions of slidings and resedimentation , the fauna coming from still mobile deposits did not undergone a transport, being redistributed and mixed with the autochthonous small mactra fauna. In case of detaching and sliding of some clayey packets they could remain as lenses incorporated in sands as alistotrimes.

According to Pătruţ (1990, p. 112) the small mactra fauna in the Văleni sands would represent intercalations between the beds with *Mactra vitaliana*, a phenomenon that can be compared with that of the intercalations with the fresh-water fauna in the Bassarabian. It is a theoretical point of view, which is not based on a detailed regional study. There were also other discussions (Saraiman, 1993) on this subject in which the authors made taxonomic confusions.

The presence of the small mactra fauna in the Văleni sands represents a reality that cannot be neglected (Martiniuc, 1948; Macarovici, Jeanrenaud, 1958; Ionesi, Ionesi, 1976).

In the Văleni sands only the small mactra assemblage (Chersonian) is autochthonous, the Bassarabian one being resedimented.

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