Acta Mineralogica-Petrographica, Szeged, XXII/2, 267—283, 1976

DATA ON THE CLASSIFICATION OF PANNONIAN SEDIMENTS OF THE ALGYŐ AREA

L. MAGYAR and I. RÉVÉSZ

ABSTRACT

This study deals with the outlined classification of the Pannonian sediments of the Algyő anticline being an intra-basin area explored most accurately by hydrocarbon prospecting bores in Hungary.

INTRODUCTION

The basement of the anticline of NW—SE strike lying northeast of the town Szeged (South Hungary) consists of Paleozoic and Precambrian metamorphites and locally of Middle Triassic dolomite. These are overlain by Neogene and Quaternary of about 2500 to 3500 m thickness. Disregarding the Miocene found only in a few bores the Pannonian sequences forms the thickest complex of the area. Its thickness varies between 1700 and 2500 metres *(Fig. 1)*.

On the area in question data were referred to by V. DANK [1965], L. VÖLGYI [1965], M. SZÉLES (1962, 1966, 1968*a*, 1968*c*, 1971] and L. KŐRÖSSY [1968, 1971].

Our elaboration contains the data of about 450 bores of incomplete core sampling, out of them 100 were drilled down to the basement, the others only down to the boundary of the Lower and Upper Pannonian. In the work the practical bore documentation was also used. The fauna determinations were carried out partly in the laboratory of Budapest of the OKGT OGIL (Oil and Gas-Industrial Laboratory), partly in the Department for Material Testing of the OKGT NKFÜ. Disregarding the accessory elements the species found were summarized in tables *(Figs. 2—6)*. One occurrence denotes one bore. Since in case of determination the piece number of each species was not given, in the figures often only estimated piece numbers are found *(Figs. 3 and 5)*. This, however, does not essentially influence the determination of the dominancy conditions *(Fig. 6)*. When adding 82 m in average to the data of depth below sea level demonstrated in *Figs.* 2 to 5 the depth of occurrence below the surface of all species can be obtained.

THE LOWER PANNONIAN

It transgressively overlies the emerging block of the basement resp. locally the Miocene. Its thickness is 500 to 1300 metres. In general it is divided into four lithologically different horizons among which faunistical differences also exist *(Fig. 1)*. From down to upwards these are as follows: 1. gravelly sandstore — conglomerate; 2. lime marl; 3. clay marl; and 4. sandstony sequence. In several places one or two of the initiating members may be absent. In these cases the Lower Pannonian begins directly with lime marl or clay marl.

The fauna of the Lower Pannonian consists mainly of benthonic elements, the nekton is represented by fish remnants. Thecamoeba are represented by three Silicoplacentina, Lamellibranchiata by twenty (out of them 14 Limnocardium and 5

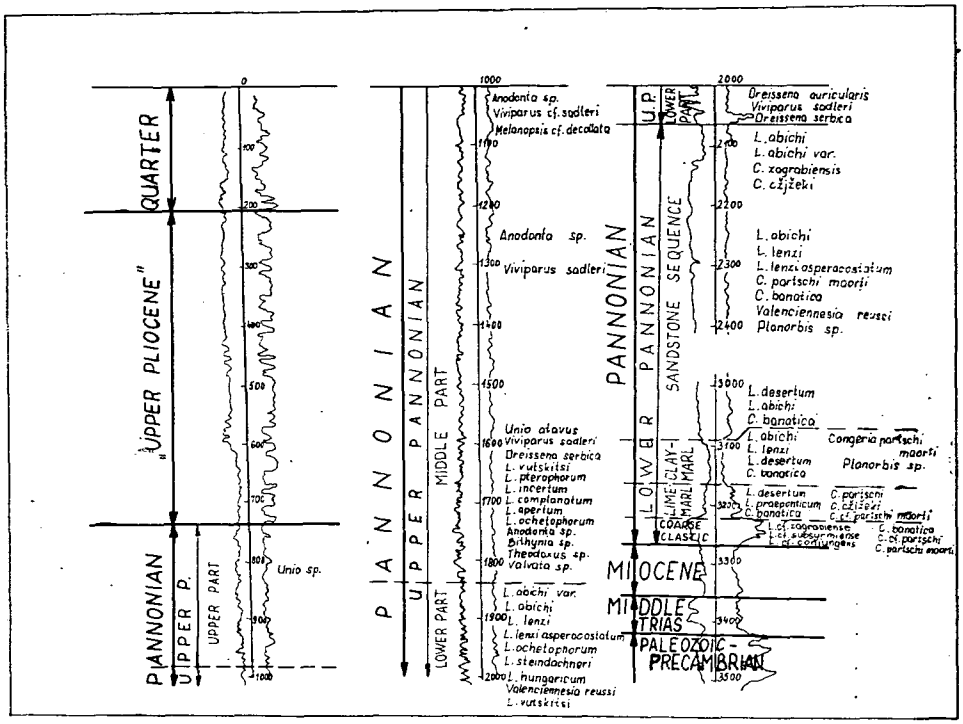


Fig. 1. Typical profile of the Algyő area. Classification and theoretical position of the important species of the Pannonian. — *Legend:* L. = Limnocardium; C. = Congeria; P. = Pannonian; U. P. = Upper Pannonian.

Congeria regarding their genera), Gastropoda by four and Ostracoda by three species. In the coarse starting strata sometimes mollusc shells also remain and numerous stone prints are also found. In the other part of the substage, however, almost only prints are found and 95 per cent of them is connected with the clay marl intercalations.

1. The coarse-clastic sequence overlies transgressively the basement. Its average thickness is 30 to 40 m, maximal thickness is 79 m. It may wedge both in high and in deep position. It consists of gravelly sandstone of changing grain size as well as of conglomerate containing quartz and metamorphite pebbles. The lowest part is the coarsest, upwards it becomes gradually finer. By means of fine-stratigraphic methods the sequence can be divided into subrhythms.

Its fauna is poorish and poorly preserved, in most cases it is restricted only to genus or species which can be determined only by cf. *(Figs. 2* and *3)*. The fauna elements derive from a depth of 2380 to 2450 m below sea level and are assigned mostly to the genera Limnocardium and Congeria. Each species are usually restricted only to one or two bores, thus the dominancy conditions cannot be evaluated.

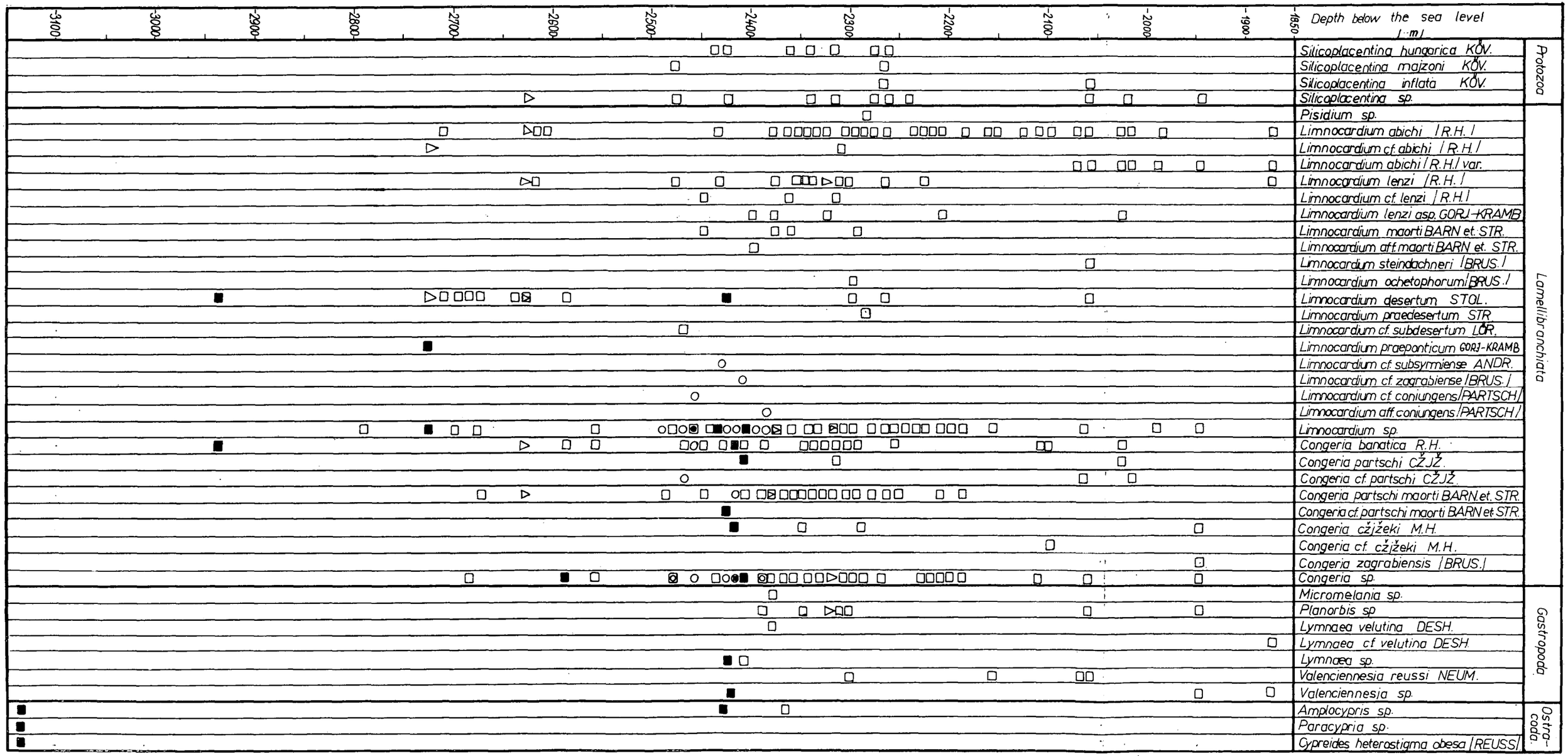


Fig. 2. Occurrence of the Lower Pannonian species of the Algyő area as a function of depth. —
Legend: ○ coarse clastic
■ lime-marl sequence
△ clay-marl
□ sandstony
asp. = asperocostatum

2. The coarse clastics resp. where this is absent the old basement are overlain by brownish-grey, in deeper positions by dark-coloured and brittle marl and lime marl in a thickness of 20 to 30 metres in average. Its formation relates to deeper-water reduction environment. It may wedge both in high and in deep positions.

Sequence		Species	Protozoa				Lamellibranchiata																																Gastropoda						Ostracoda		
			Silicoplacentina hungarica KÖV.	Silicoplacentina majzoni KÖV.	Silicoplacentina inflata KÖV.	Silicoplacentina sp.	Pisidium sp.	Limnocardium abichi (R.H.)	Limnocardium cf. abichi (R.M.)	Limnocardium abichi (R.H.) var.	Limnocardium lenzi (R.H.)	Limnocardium cf. lenzi (R.H.)	Limnocardium lenzi asp. GORJ.-KRAMB.	Limnocardium maorti BARN.et STR.	Limnocardium aff. maorti BARN.et STR.	Limnocardium steindachneri (BRUS.)	Limnocardium ackerphorum (BRUS.)	Limnocardium desertum STOL.	Limnocardium praedesertum STR.	Limnocardium cf. subdesertum LÖR.	Limnocardium praeponticum GORJ.-KRAMB.	Limnocardium cf. subsyrmense ANDR.	Limnocardium cf. zagrabiense (BRUS.)	Limnocardium cf. conjungens (PARTSCH.)	Limnocardium aff. conjungens (PARTSCH.)	Limnocardium sp.	Congeria banatica R.H.	Congeria partschi CŽJŽ.	Congeria cf. partschi CŽJŽ.	Congeria partschi maorti BARN.et STR.	Congeria cf. partschi maorti BARN.et STR.	Congeria čžjžeki M.H.	Congeria cf. čžjžeki M.H.	Congeria zagrabiensis (BRUS.)	Congeria sp.	Micromelania sp.	Planorbis sp.	Lymnaea velutina DESH.	Lymnaea cf. velutina DESH.	Lymnaea sp.	Valenciennesia reussi NEUM.	Valenciennesia sp.	Amplocypris sp.	Paracypria sp.	Cyprideis heterostigma obesa (REUSS)
4	N. b.		7	2	2	8	1	29	1	7	12	3	5	3	1	1	1	6	1	1	—	—	—	—	—	33	17	2	2	22	—	3	1	1	32	1	6	1	1	1	4	2	1	—	—
	P. c.		7	2	2	10	1	47	1	8	18	3	5	4	1	1	1	11	1	1	—	—	—	—	—	81	23	2	2	27	—	3	1	1	59	1	7	1	1	1	4	2	1	—	—
3	N. b.		—	—	—	1	—	1	1	—	2	—	—	—	—	—	—	2	—	—	—	—	—	—	—	3	1	—	—	2	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—
	P. c.		—	—	—	1	—	1	1	—	2	—	—	—	—	—	—	2	—	—	—	—	—	—	—	3	1	—	—	2	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—
2	N. b.		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	3	4	1	—	—	1	1	—	—	5	—	—	—	—	1	—	1	2	1	1
	P. c.		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	1	—	—	—	—	3	4	1	—	—	1	1	—	—	9	—	—	—	—	1	—	1	2	1	1
1	N. b.		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	11	1	—	1	1	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—
	P. c.		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	1	1	15	3	—	1	1	—	—	—	—	12	—	—	—	—	—	—	—	—	—	—

1 Coarse clastic 2 Lime-marl 3 Clay-marl 4 Sandstone sequence

Fig. 3. Occurrence of the Lower Pannonian species of the Algyő area according to the bores and number of pieces.
Legend: N. b. = number of bores;
P. c. = number of pieces;
asp. = asperocostatum

Its fauna is somewhat richer than that of the previous sequence. The genera Limnocardium and Congeria are predominant but gastropods and ostracods also occur. The marginal, i. e. deeper bores (deeper than 2720 m below the sea level) are characterized by *Limnocardium desertum* STOL. or by *Congeria banatica* R. H. In the bore Algyő—18 the core between 2936 and 2940 metres contained the two species together. In the lime marl of 4 m of the core between 2724 and 2742 metres of the neighbouring Algyő—8 bore *Limnocardium praeponticum* GORJ.-KRAMB. and *Limnocardium sp.* were determined. Thus, the lime marl of these two bores can be roughly correlated with the upper part of the preaponticum-horizon recorded by Á. JÁMBOR and M. KORPÁS-HÓDI [1971] in the Lajoskomárom—1 bore of Transdanubia. In the strata of central, *i. e.* higher position (between 2400 and 2720 m below sea level) also the *Limnocardium desertum* STOL. and the *Congeria banatica* R. H. are most frequent, but in addition to them the species *Congeria partschi* CŽJŽ., *Congeria cf. partschi maorti* BARN et STR., *Congeria čžjžeki* M. H., *Valenciannesia sp.* and *Lymnaea sp.* are also found in each bores and are represented by one-one specimen.

3. As against the two previous sequences, the clay marl sequence is of regional extension. Its average thickness is 40 to 50 metres. In certain cases this amounts to only 10 to 20 and in a few places to more than 100 metres. In several places (*i. e.* in top-position) it directly overlies the basement. It consists primarily of dark-grey clay marl and subordinately of fine aleurite. It is nearly completely sand-free. It may contain sporadically lime marl strips resp. quartz and metamorphite pebbles at the edges of the structure. In such case the lime marl sequence resp. the coarse-clastic sequence can be considered to be heteropic facies.

Due to the small number of core samples only insufficient data known on the fauna (*Figs. 2* and *3)*. The species derive from the depth interval of 2320 to 2720 metres below sea level. The *Limnocardium desertum* STOL. and the *Congeria banatica* R. H. spreading from the lower sequence across to this horizon but the *Limnocardium abichi* (.R H.) and the *Limnocardium lenzi* (R. H.) being of increasing importance also occur. The Silicoplacentina are also found. The gastropods are represented by the *Planorbis sp.* Similarly to the lime marl, probably the *Congeria banatica* R. H. and the *Limnocardium desertum* STOL. are most frequent also in this horizon.

4. The thickness of the sansdtony sequence amounts to 500 to 1000 metres. In higher position it is thinner, while in deeper one it is thicker. It consists of the monotonous rhythmic alternation of grey aleurite, dark-grey clay marl light-grey fine resp. medium-fine sandstone. The sandstones may be either thin- and thick-bedded or lamellar. They are mostly fine-grained, subordinately very fine-grained, the medium-grained varieties occur sporadically. Gravel substance is absolutely absent. The rhythms are thicker down (50 to 100 m) and thinner upwards (20 to 30 m). Their number is 7 to 8, max. 22. The proportion of the sandstone strata of the sequence estimated on the basis of carottage profiles is about 15 per cent.

The pelitic intercalations of the sequence is characterized by abundant fauna regarding the numbers of both the species and individuals. The species were found in the depth interval between 1870 and 2790 m below sea level *(Fig. 2)*. On faunistic bases further three parts can be distinguished (which cannot be performed from the petrological point of view): *a)* a lower horizon poorest in fauna (below the 2420 m level below the sea level);*b)* a medium section of most abundant fauna (in the depth interval between 2120 and 2420 m below sea level); *c)* an upper part of medium-rich fauna (above the depth level of 2120 m below sea level). (It is to be noted here that in the fauna abundance of the middle section the greatest number of core samples is of primordial role.)

The fauna of the lower part consists solely of Limnocardium and Congeria. The *Limnocardium desertum* STOL. is the most frequent and wide-spread species. The abundance of this species of long generation seems to fall into this period. In addition to it *Limnocardium abichi* (R. H.) and *Congeria banatica* R. H. are important, further *Limnocardium lenzi* (R. H.) and *Congeria partschi maorti* BARN. et STR. are also found.

The middle part is of more variegated and abundant fauna. The significance of the genus Silicoplacentina increases. Out of their three species the *Silicoplacentina hungarica* KŐV. is most frequent. Out of the molluscs the species *Limnocardium abichi* (R. H.) is extraordinarily dominant (and at the same time abundant) which is frequent mainly above the depth of 2320 m below the sea level. As against the statement of M. SZÉLES [1971] not the *Limnocardium lenzi* (R. H.) but the species *Congeria partschi maorti* BARN. et STR. is subdominant. (The difference may be caused by the fact that she assigns the "transitional zone" between the Lower and Upper Pannonian — the lower part of which is characterized by relatively frequency of

the *Limnocardium lenzi* (R. H.) — to the Lower Pannonian). The third most frequent species is the *Congeria banatica* R. H. and this is followed by the *Limnocardium lenzi* (R. H.), see *Fig. 6.* (All these dominance conditions are valid of the whole sandstony sequence.) The *Congeria partschi* CŽJŽ. and the *Congeria czjzeki* M. H. are rare, the *Limnocardium lenzi asperocostatum* GORJ.-KRAMB. and the *Limnocardium ochetophorum* (BRUS.) also occur. Out of the gastropods the *Valenciannesia reussi* NEUM. and the *Planorbis sp.* are most significant. Ostracods are represented only by the *Amplocypris sp.*

The fauna of the upper part shows certain transition towards the Upper Pannonian. The *Limnocardium abichi* (R. H.) is dominant, the *Congeria banatica* R. H. is frequent, the *Limnocardium abichi* (R. H.) *var.* and the *Limnocardium steindachneri* (BRUS.) also occur. The *Limnocardium desertum* STOL., the *Limnocardium lenzi* (R. H.), the *Limnocardium lenzi asperocostatum* GORJ.-KRAMB., the *Congeria partschi* CŽJŽ., the *Congeria czjzeki* M. H. and the *Congeria zagrabiensis* (BRUS.) can be found in a few occurrences *(Figs. 2, 3* and *6).*

The fauna has been discussed while following the lithofaciological units. Biostratigraphically, however, the following three horizons can be distinguished:

1. The coarse clastics, the lime marls, the clay marl sequence of the deep-seated areas as well as the lower thick-bedded part of the sandstony sequence are assigned to the lower part (roughly below the depth level of 2420 m below sea level). Its littoral fauna is represented by a few and poorly preserved species *(Figs. 1* and *2).* Its intrabasin formation is characterized by *Congeria banatica* R. H. in the lower part and by *Limnocardium desertum* STOL. in the upper part though the former is continuously significant. In the lowermost horizon the *Limnocardium praeponticum* GORJ.-KRAMB is also found. After the deposition of the lime marl strata the *Limnocardium abichi* (R. H.) and the *Limnocardium lenzi* (R. H.) occur in the clay marl sequence and become of ever growing importance from down to upwards.

2. The part of the sandstony sequence lying between 2120 and 2420 m below sea level is assigned to the middle part and which can be characterized with decreasing frequency by the *Limnocardium abichi* (R. H.), *Congeria partschi maorti* BARN. et STR., *Congeria banatica* R. H. and *Limnocardium lenzi* (R. H.) This sequence is most abundant fauna composition *(Figs. 1* and *2).*

3. The upper part of the sandstony sequence of about 200 m thickness extending up to the boundary of the Lower and Upper Pannonian is assigned to the upper part. In this sequence also the *Limnocardium abichi* (R. H.) is dominant but its aberrant variety, the *Limnocardium abichi* (R. H.) *var.* also occurs. Consequently, certain transition is shown towards the Upper Pannonian. On the basis of the relatively great number of common species (*i. e. Limnocardium steindachneri* (BRUS.), *Limnocardium lenzi* (R. H.), *Congeria zagrabiensis* (BRUS.) *Congeria czjzeki* M. H. this horizon can be roughly correlated with the upper marginal horizon of Á. JÁMBOR, M. KORPÁS-HÓDI, [1971].

THE UPPER PANNONIAN

Its thickness is 1200 to 1400 m. It overlies the Lower Pannonian by angular discordance. Both the lower and the upper boundaries of it can be drawn only lithologically. Its lower boundary is marked by strong sandification shown also by the carottage profiles and this is for the most part accompanied by significant change of fauna. Its upper boundary is marked at the floor of the first thick-bedded and high-resistant sand layer lying between 650 and 750 m below sea level. The sequence extend-

ing from this horizon up the Quaternary is not assigned to the Upper Pannonian but this will be separately discussed under the term "Upper Pliocene" *(Fig. 1)*.

The Upper Pannonian sequence is of regressive character. It is characterized by the sudden increase of sandstones up to 40 per cent in average (value estimated on the basis of profiles). Its petrological picture is much more variegated than that of the Lower Pannonian. The three main rock types are also the sandstone, aleurite and clay marl (though the latter is considerably restricted), the sandstone lenses of 20 to 50 cm, max. 1 to 2 m thickness and of hard carbonate cementing material as well as the lime-marl, woody brown-coal and coaly clay intercalations are rather frequent. In addition to this quartz pebbles occur though sporadically. All these fairly reflect the changed sedimentary environments. The thickness of the unstratified parts of the same material is 5 to 10 m at least and only above 1200 to 1300 m occur the thicker (20 to 30 m) homogeneous strata.

Its fauna is much more abundant than that of the Lower Pannonian *(Figs. 4* and *5)*. The number of species and individuals is suddenly increasing. The fauna of the substage consists of 4 Thecamoeba, 40 Lamellibranchiata (out of them 27 is assigned to the genus Limnocardium), 14 Gastropoda and 17 Ostracoda species *(Fig. 5)*. Most of them derive from the best discovered lower part of 300 m; above this horizon only several data are available. Since the boundary between the lower and middle part of the substage is not always sharp, in case of demonstrating the fauna the separation according to horizons was neglected *(Figs. 4* and *5)*. In addition to the clay marl, the enclosing rock is often sandstone or coaly clay.

The Hungarian Upper Pannonian sequence including the "Upper Pliocene" separated by us was divided into three horizons by F. BARTHA [1971*a*, *b*, 1974, 1975]. Mainly M. SZÉLES [1962, 1966, 1968*c*, 1971] dealt with the intra-basin Upper Pannonian fauna of the Great Plain. She stated the mixing of the Lower and Upper Pannonian fauna in the lower 200—300 metres of the Upper Pannonian of F. BARTHA [1971*a*, *b*, 1974, 1975] determined in the Algyő area and she assigned this part as a "transitional zone" to the Lower Pannonian.

On the basis of partly the fauna (in the lower section) and partly the lithology, the Upper Pannonian of Algyő is divided by ourselves as follows:

1. Lower sequence. This extends from lithologically drawn lower boundary (1900—2120 m below sea level) up to the faunistically drawn upper boundary (about 1720—1830 m below sea level). Roughly the "transitional zone" of M. SZÉLES is included within this zone. Its varied rock types show the fundamental changes of the sedimentary environments. Thinner (max. 50 cm thick) woody brown-coal and coaly clay strata are present already from the lowermost part of the horizon. Upwards, around the boundary of the middle horizon no sharp lithological change can be observed, only the increase of small extent of the number of woody brown-coal and coaly clay strata being frequent in the whole sequence can be observed in the core samples. Further evidences of shallowing are the frequently observable coaly plant fragments in the aleurites and sandstones of the core samples, the coal bands of several millimetres and locally the traces of drying. In the lower member the filling up was of considerable measure so in addition to the shallow lacustrine environment marshy and bog environments also occur. Smaller islands might exist but continuous greater lands could not be found. The origin of the quartz pebbles occuring sporadically in the whole sequence is debated. The listed sedimentary environments alternate spatially beside one another and temporally subsequently forming thus a jagged sequence. According to M. MUCSI [1973] and M. MUCSI, I.

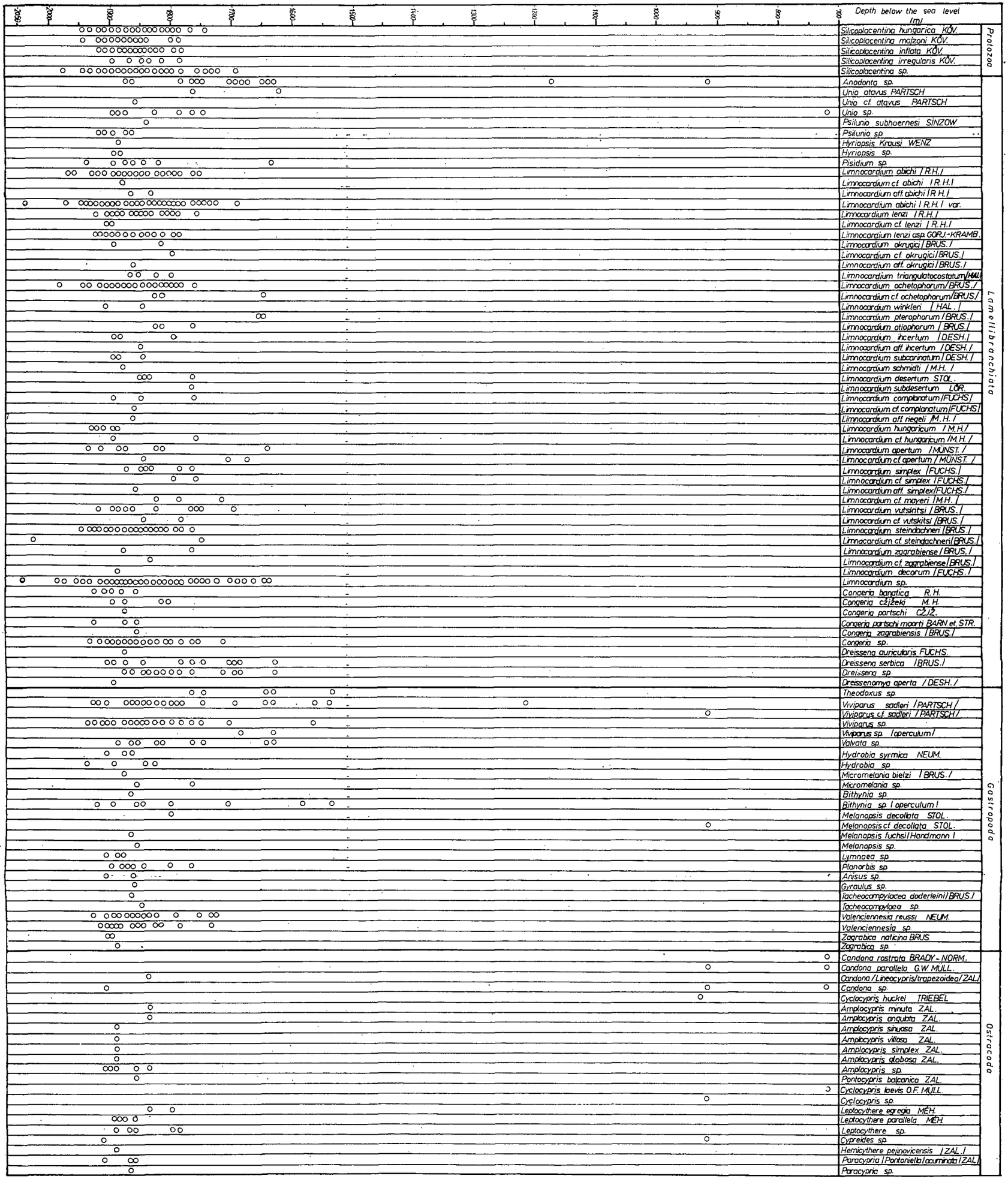


Fig. 4. Occurrence of the Upper Pannonian species of the Algyő area as a function of depth.
Legend: asp. = asperocostatum

	Species	Nb	Pc.
Protozoa	Silicoplacentina hungarica KÖV.	41	60.
	Silicoplacentina majzoni KÖV.	15	17
	Silicoplacentina inflata KÖV.	18	20
	Silicoplacentina irregularis KÖV.	5	7
	Silicoplacentina sp.	51	88
Lamellibranchiata	Anadonta sp.	17	20
	Unio atavus PARTSCH	2	2
	Unio cf. atavus PARTSCH	1	1
	Unio sp.	7	8
	Psilunio subhoernesi SINZOW	1	1
	Psilunio sp.	5	7
	Hyriopsis Krausi WENZ	2	2
	Hyriopsis sp.	2	2
	Pisidium sp.	7	7
	Limnocardium abichi (RH.)	30	43
	Limnocardium cf. abichi (R.H.)	2	2
	Limnocardium aff. abichi (R.H.)	1	1
	Limnocardium abichi (R.H.) var.	202	484
	Limnocardium lenzi (R. H.)	14	16
	Limnocardium cf. lenzi (R.H.)	1	1
	Limnocardium lenzi asp. GORJ-KRAMB	42	51
	Limnocardium okrugici (BRUS.)	2	2
	Limnocardium cf. okrugici (BRUS.)	1	1
	Limnocardium aff. okrugici (BRUS.)	1	1
	Limnocardium triangulatocostatum (HAL.)	4	4
	Limnocardium ochetophorum (BRUS.)	77	98
	Limnocardium cf. ochetophorum (BRUS.)	3	3
	Limnocardium winkleri (HAL.)	2	2
	Limnocardium pteraphorum (BRUS.)	1	1
	Limnocardium otiaphorum (BRUS.)	1	3
	Limnocardium incertum (DESH.)	3	3
	Limnocardium aff. incertum (DESH.)	1	1
	Limnocardium subcarinatum (DESH.)	3	3
	Limnocardium schmidti (M.H.)	1	3
	Limnocardium desertum STOL.	5	5
	Limnocardium subdesertum LÖR.	1	1
	Limnocardium complanatum (FUCHS.)	1	3
	Limnocardium cf. complanatum (FUCHS)	1	1
	Limnocardium aff. riegeli (M.H.)	1	1
	Limnocardium hungaricum (M.H.)	5	5
	Limnocardium cf. hungaricum (M.H.)	2	2
	Limnocardium apertum (MUNST.)	6	6
	Limnocardium cf. apertum (MUNST.)	3	3
	Limnocardium simplex (FUCHS)	6	7
	Limnocardium cf. simplex (FUCHS.)	2	2
	Limnocardium aff. simplex (FUCHS.)	1	1
	Limnocardium cf. mayeri (M.H.)	3	3
	Limnocardium vutskitsi (BRUS.)	11	14
	Limnocardium cf. vutskitsi (BRUS.)	2	2
	Limnocardium steindachneri (BRUS.)	50	58
	Limnocardium cf. steindachneri (BRUS.)	2	2
	Limnocardium zagrabiense (BRUS.)	2	2
	Limnocardium cf. zagrabiense (BRUS.)	1	1
	Limnocardium decorum (FUCHS.)	1	1
	Limnocardium cristagalli (ROTH)	1	1
	Limnocardium cf. prionophorum (BRUS.)	1	1
	Limnocardium sp.	198	416
	Congeria banatica R.H.	5	5
	Congeria čžiževki M.H.	4	6
	Congeria partschi CŽJŽ.	2	2
	Congeria partschi maortiBARNet. STR.	4	4
	Congeria zagrabiensis BRUS.	1	1
	Congeria sp.	37	60
	Dreissena auricularis FUCHS.	1	1
	Dreissena serbica BRUS.	12	22
	Dreissena sp.	14	17
	Dreissenomya aperta (DESH.)	1	1

	Species	Nb	Pc
Gastropoda	Theodoxus sp.	4	6
	Viviparus sadleri (PARTSCH.)	21	28
	Viviparus cf. sadleri (PARTSCH.)	1	1
	Viviparus sp.	38	47
	Viviparus sp. (operculum)	1	2
	Valvata sp.	9	10
	Hydrobia syrmica NEUM.	3	3
	Hydrobia sp.	4	4
	Micromelania bielzi (BRUS)	1	1
	Micromelania sp.	2	2
	Bithynia sp.	1	1
	Bithynia sp. (operculum)	9	11
	Melanopsis decollata STOL.	1	1
	Melanopsis cf. decollata STOL.	1	1
	Melanopsis fuchsi (HANDMANN.)	1	1
	Melanopsis sp.	1	1
	Lymnaea sp.	6	6
	Planorbis sp.	9	9
	Anisus sp.	2	2
	Gyraulus sp.	1	1
	Tacheocampylaea doderleini (BRUS.)	1	1
	Tacheocampylaea sp.	1	1
	Valenciennesia reussi NEUM.	28	33
	Valenciennesia sp.	15	16
	Zagrabica naticina BRUS.	2	2
	Zagrabica sp.	1	1
Ostracoda	Candona rostrata BRADY – NORM.	1	1
	Candona parallela G.W. MÜLL.	1	2
	Candona (Lineocypris) trapezoidea (ZAL.)	1	1
	Candona sp.	2	3
	Amplocypris minuta ZAL.	1	1
	Amplocypris angulata ZAL.	1	1
	Amplocypris sinuosa ZAL.	1	1
	Amplocypris villosa ZAL.	1	1
	Amplocypris simplex ZAL.	1	1
	Amplocypris globosa ZAL.	1	1
	Amplocypris sp.	5	5
	Pontocypris balcanica ZAL.	1	1
	Cyclocypris laevis O.F. MÜLL.	1	1
	Cyclocypris huckei TRIEBEL	1	1
	Cyclocypris sp.	1	1
	Leptocythere egregia MÉH.	2	2
	Leptocythere parallela MÉH.	4	4
	Leptocythere sp.	10	10
	Cypreides sp.	2	2
	Hemicythere pejnovicensis (ZAL.)	1	1
	Paracypria (Pontoniella) acuminata (ZAL.)	4	4
	Paracypria sp.	1	1

Fig. 5. Occurrence of the Upper Pannonian species of the Algyő area according to the bores and number of pieces.
Legend: see Fig. 3.

RÉVÉSZ [1975] the upper two-third of the sequence is characterized by the delta sedimentation and by the related environments.

Regarding the fauna the great aberrant varieties of the *Limnocardium abichi* (R. H.) and *Limnocardium lenzi* (R. H.) spreading from the Lower Pannonian are most characteristic of this sequence. The varieties of the former species were described by M. SZÉLES [1962] as *Limnocardium abichi* (R. H.) *var.* which is extremely dominant and at the same time abundant in the whole lower sequence. Further significant species spreading across to the Upper Pannonian are the following: the subdominant *Limnocardium ochetophorum* (BRUS.), the third most frequent *Limnocardium steindachneri* (BRUS.), as well as the *Valenciennesia reussi* NEUM., *Limnocardium desertum* STOL., *Congeria banatica* R. H., *Congeria czjzeki* PARTSCH, *Congeria partschi maorti* BARN et STR. *(Fig. 6)*. Species becoming more significant only in the upper parts of the Upper Pannonian also occur. Out of them the *Viviparus sadleri* (PARTSCH), the *Psilunio sp.* and the *Hydrobia sp.* appear already at the bottom of the horizon, the *Limnocardium vutskitsi* (BRUS.), the Dreissena and Bithynia in the lower third, while the Hyriopsis, Anodonta, Tacheocampylaea and Unio genera occur first somewhat later. The change of the lithofacies, however, does not correlate always with the appearance of new species. In two cases a fauna of exactly Upper Pannonian character was found below the Lower — Upper Pannonian boundary determined by electric profiles. Between 1915 and 1930 m below sea level of the bore Algyő 363. *Viviparus sadleri* (PARTSCH) and *Psilunio sp.* were found together with *Limnocardium steindachneri* (BRUS.) and *Limnocardium hungaricum* (M. H.). Between 1919.5 and 1937.5 m below sea level in the bore of Algyő 392. the fauna assemblage consists of *Viviparus sp., Pisidium sp., Limnocardium steindachneri* (BRUS.) and *Hydrobia sp.* These occurrences were of course assigned to the Upper Pannonian.

The upper boundary of the lower sequence cannot be always exactly determined. This falls in general between 1720 and 1770 m below sea level, sometimes it lies, however, somewhat deeper. Faunistically, the upper boundary is marked by the uppermost occurrences of the *Limnocardium abichi* (R. H.), *Limnocardium lenzi* (R. H.), *Limnocardium lenzi asperocostatum* GORJ.-KRAMB., *Limnocardium desertum* STOL., *Limnocardium steindachneri* (BRUS.) and *Valenciennesia reussi* NEUM., resp- by the increased frequency of the *Anodonta sp., Dreissena, Vivipara* and *Limnocardium vutskitsi* (BRUS.).

The species of this sequence are especially facies indicators. In most of the cases the "younger" Vivipara, Bithynia, Anodonta, Psilunio, Hydrobia, Hyriopsis, Tacheocampylaea and the *Limnocardium vutskitsi* (BRUS.) occur in coaly clay intercalations. If occasionally the enclosing rock is of other type the sediments of the marshy environment can always be found in their close neighbourhood. The fauna assemblage of the sandstone called Algyő—2 fairly demonstrates this phenomenon containing coaly strata in the nortwestern part of the area (lying at about the third of the lower sequence). In the lower two-third of this the *Limnocardium abichi* (R. H.) of "older type" is found in a dominancy of 90 per cent. From the coaly clay deposited in the upper third of the sandstone the following fauna of mostly "younger type" was found: *Anodonta sp. Psilunio sp., Pisidium sp., Dreissena serbica* (BRUS.), *Hydrobia syrmica* (BRUS.), *Hyriopsis sp., Bithynia sp., Tacheocampylaea doderleini* (BRUS.) *Planorbis sp., Viviparus sadleri* (PARTSCH), *Viviparus sp., Limnocardium ochetophorum* (BRUS.), *Limnocardium vutskitsi* (BRUS.), *Limnocardium sp.* Above it the fauna elements considered to be "older" appear again indicating the return of lacustrine environment. Consequently, the environment and together with it the fauna changes cyclically.

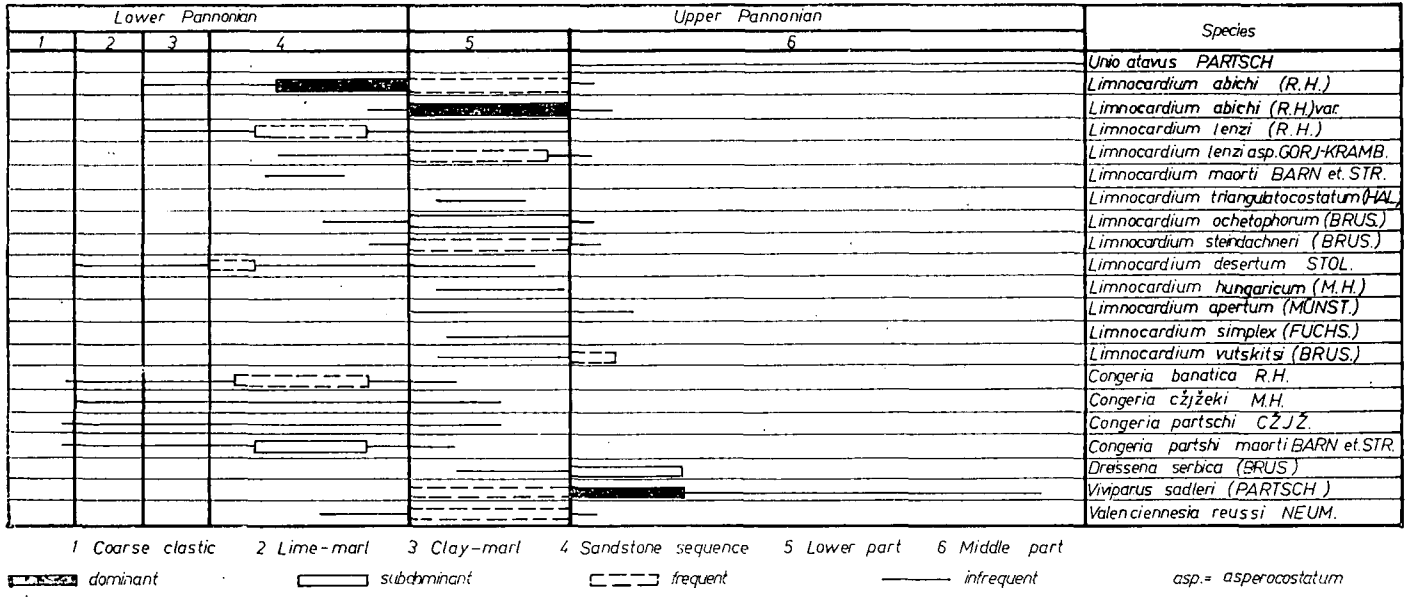


Fig. 6. Generation of the most important Pannonian species of the Algyő area.

In many cases the Dreissena are found in sandy biotope. In numerous bores of the area (e. g. Algyő—3, 11, 33, 41, 183 and 242), between the depth interval of 1760 and 1900 metres below sea level thin, non horizon-keeping, hard aleuritic-sandstony Lumasella lenses of carbonate cementing material are found in which mostly rare eastern species occur. (e. g. *Limnocardium incertum* (DESH.), *subcarinatum* (DESH.), *complanatum* (FUCHS), *Hyriopsis krausi* WENZ.). The appearance of the *Viviparus sadleri* (PARTSCH) and *Limnocarduim vutskitsi* (BRUS.) considered to be also of eastern origin is explained by F. BARTHA [1971*a*, *b*, 1974, 1975] by the short opening of the Porta Ferrea. As against the major part of our occurrences in Algyő both species occur already at the bottom of the Upper Pannonian, frequently in one occurrence in the same core sample. In the area in question the number of Viviparus occurrences amounts to 36. The *Limnocardium vutskitsi* (BRUS.) is known from six bores till now. In Algyő out of the fossils indicating the lower member (similarly to Ferencszállás lying in the direct southeastern neighbourhood) the *Dreissena auricularis* (FUCHS) occurred only in one core sample; cores, however, containing *Congeria rhomboidea* M. H. and *Congeria ungulacaprae* MÜNST. were not drilled yet.

The classification of age of the sequence is debated. The boundary between the Lower and Upper Pannonian is drawn by M. SZÉLES [1966, 1968*a*, 1968*c*, 1971] and J. KŐVÁRY [1973] on faunistical bases, by É. SZABÓ.-KILÉNYI and GY. SZÉNÁS [1971] on the basis of seismic profiles at the top of the sequence. On the contrary, mostly on lithological bases L. VÖLGYI [1965], L. KŐRÖSSY [1968, 1971], L. VÖLGYI, K. BALLA, S. SUBA, I. CSALAGOVITS [1970], F. BARTHA [1971*a*, 1974, 1975] and M. MUCSI, I. RÉVÉSZ [1975] put it to the bottom of the sequence. The assignment of the seqence in question is evidenced by the following reasons:

a) On the basis of the geophysical profiles and core samples the percentual ratio of the sand strata suddenly increases at the bottom of the sequence.
b) In the sequence varied sedimentary environments are found. Most important is the presence of the intercalations of woody brown-coal and coaly clay strata since the beginning of the sequence.
c) The carbonate content is somewhat lower than in the Lower Pannonian.
d) As against the Lower Pannonian in the lower sequence (but also in the lower two-third of of the middle sequence) only thinner (max. 5 to 10 metres)

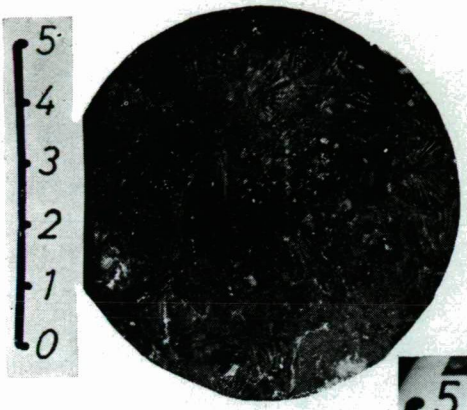
EXPLANATION OF PLATES

PLATE I

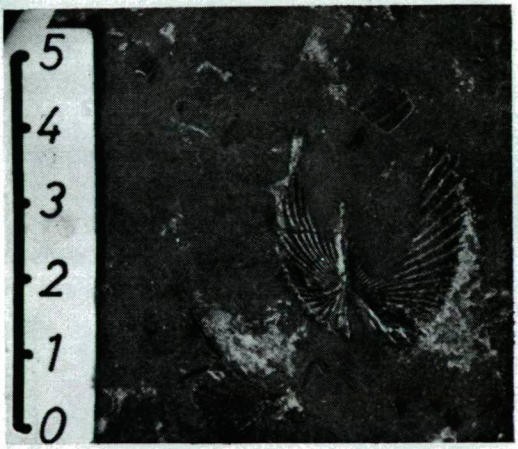
1. Clay marl containing *Congeria banatica* R. H. and *Limnocardium abichi* (R. H.). Lower Pannonian. — Bore Algyő 8. 2683—2687 m.
2. *Limnocardium steindachneri* (BRUS.), *Limnocardium sp.* in fine-grained aleurite. Upper Pannonian. — Bore Algyő 290. 1960—1965 m,
3. *Viviparus sadleri* (PARTSCH) in coaly clay. Upper Pannonian. — Bore Algyő 360. 1995—2007 m

PLATE II

1. Clay marl containing *Viviparsu sadleri* (PARTSCH). Upper Pannonian. — Bore Algyő 279. 1870—1882 m.
2. *Limnocardium abichi* (R. H.) and *Limnocardium abichi* (R. H.) *var.* in clay marl. Upper Pannonian. — Bore Algyő 399. 1956—1973 m.
3. *Dreissena sp., Congeria partschi maorti* BARN. et STR. and *Congeria sp.* in limy aleurit. — Bore Algyő 3. 1966,5—1984,5 m.



1

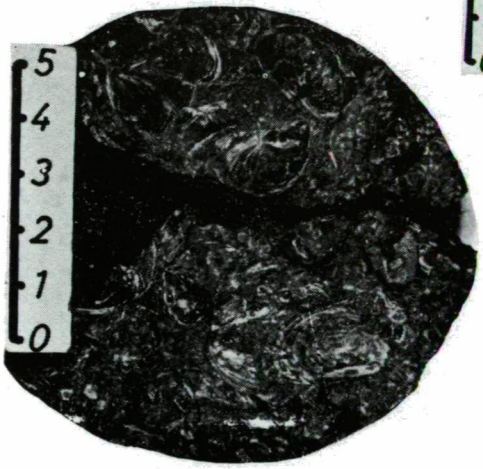


2

3

1

2



3

homogeneous strata are found. This indicates the considerable change of kinetic energy of the deposition medium.

e) On the basis of grain size distribution investigations strong fluctuation of sorting begins in the lower sequence.

f) The composition of the fauna makes also evidences to assign the sequence into the Upper Pannonian. Nevertheless, it is true that the brackish species of the Lower Pannonian are predominant, but in the lower part of the sequence (sometimes in its lowermost part) the eastern Caspian brackish species appear, moreover these are relatively frequent. (Regarding the frequency the *Viviparus sadleri* (PARTSCH) is the seventh among the species.) The great aberrant fossils of the *Limnocardium abichi* (R. H.) and *Limnocardium abichi* (R. H.) indicate undoubtedly the fundamental change of the sedimentary environments.

g) The data of salt content of the strata carried out in the hydrocarbon prospecting bores (referring to NaCl according to VOLHARD) show that the sediments of the lower part bear freshwater. All the results lie below 0.5 g/l, moreover, fall between 0.05 and 0.11 g/l. On the contrary, in the Lower Pannonian just somewhat below the Lower — Upper Pannonian boundary values greater by an order of magnitude, *i. e.* 1 to 3 g/l are found.

2. Middle sequence. Its upper boundary can be drawn between 900 and 1100 metres below sea level by means of the upward lack of the frequently and continuously occurring thicker woody brown-coal lenses being predominant in the depth cited *(Fig. 1)*. (Higher up there are also sporadically lignite strata but these are thin.) The marshy strata disappear by certain time difference in different bores, thus the boundaries marked by means of them can be only hardly correlated.

This means that the Pannonian inland lake was decomposed into parts just at the beginning of the middle sequence, as a result of the high-grade filling up, the shallow lacustrine environment lost its predominance and forwarding upwards the marshy strata become gradually predominant. While on the basis of the core samples in the lower sequence only woody brown-coal strata of 20 to 50 cm thickness can be demonstrated, from the bottom of the middle sequence those thicker than one metre also occur. The sediments are loose, in general. The clay marls and aleurites are of lighter colour, greyish-green, occasionally yellowish shade of colour, and are often of ochre spots and lime concretions. Unfortunately, on the basis of cores only the lower section of 100 to 150 metres are better known, on the upper parts in addition to the few cores the bore material and the electric profiles give some information. According to these upward from the detph of 1100 to 1200 m below sea level homogeneous strata of 20 to 30 m thickness are also found.

As a result of the incomplete core sampling the fauna of only the lower part of 100 to 150 m is known in detail. At the lower boundary drawn on faunistical bases the species characteristic of the lower section disappear and are replaced by "typical" Upper Pannonian forms.

Some individuals of the Silicoplacentina which can be determined only by genera occur already in the lower part of the sequence. Lamellibranchiata are represented by 16, Gastropoda by 6 species. Regarding the number of species the Limnocardium is predominant (11 species) but out of them only the *Limnocardium vutskitsi* (BRUS.) is frequent. It was found in seven bores up to 1690 metres below sea level. In addition to it only the *Limnocardium abichi* (R. H.) *var.* (uppermost occurrence between 1685 and 1703 m below sea level), the *Limnocardium ochetophorum* (BRUS.)

and the *Limnocardium apertum* (MÜNST.) are of greater significance. All the other species of Limnocardium were found only in one or two bores in one or two specimens *(Figs. 4* and *5)*.

The role of *Anodonta sp.* considerably increases (18 pieces at 15 occurrences). The lack of *Unio atavus* PARTSCH, *Unio sp.* and *Pisidium sp.* in the upper parts is caused probably by the incomplete core sampling. *Congeria sp.* were found up to 1720 m below sea level and are characterized by some individuals which can be determined only in generic level. The Dreissena of great importance are found up to 1620 m below sea level, mostly in sandstone lenses. *Dreissena serbica* (BRUS.) and *Dreissena sp.* were found in seven (17 specimen) resp. eight (9 specimen) bores. Out of the gastropods Vivipara are of greatest importance, these occur continuously up to 1540 m below sea level and only sporadically above this depth. Up to now these were found in 20 bores. The following fossils are worthy of mention: *Theodoxus sp., Bithynia sp., Valvata sp., Planorbis sp.* and *Melanopsis cf. decollata* STOL. (Their infrequent occurrence is caused by all means by rare core sampling.)

In the middle third of the sequence no faunabearing core drilling was performed, only in the upper third gives some information. In 1170 m of Algyő—1 *Anodonta sp.*, in 1220 m of Algyő—4 *Viviparus sadleri* (PARTSCH), in 920 m of Deszk—1 *Anodonta sp., Viviparus cf. sadleri* (Partsch) and *Melanopsis cf. decollata* STOL. were found (data of depth below sea level). The latter species indicate the uppermost part of the sequence.

3. The upper sequence lies between the depth interval of 900—1100 m below sea level up to the bottom of the thick-banked sand strata of high resistance occurring between 650 and 750 m below sea level *(Fig. 1)*. This boundary, however, may fluctuate laterally by 20 to 50 metres. The filling up had been of very high rate so that the Pannonian inland lake ceased and the fluvio-lacustrine sedimentation became predominant. The most important rocks are as follows: greenish-grey clay often of ochre spots and lime concretions, aleurite and light-grey sand. Rarely thin peat and coaly clay intercalations as well as smaller banks consisting of small-grained quartz pebbles are found. Only one core was drilled in this sequence. Between the depth interval of 715 and 721 m below sea level of the bore Deszk—1 *Unio sp.* Ostracoda were determined *(Fig. 4)*.

The correlation of the trisected Upper Pannonian of the Algyő area with the contemporaneous sediments of other intrabasin sequences and especially with those of the marginal areas is recently rather troublesome. According to the analogies of other intrabasin occurrences the lower sequence corresponds to the horizons characterized by Ungulacaprae and Subglobosa. In the middle sequence out of the species characteristic of the marginal parts of the basin the *Congeria balatonica* PARTSCH and the *Congeria triangularis* PARTSCH do not occur, instead of them the *Viviparus sadleri* (PARTSCH), the *Limnocardium vutskitsi* (Brus.) and the *Dreissena serbica* (BRUS.) are most frequent. The woody brown-coal and coaly clay strata are common also in Algyő, but occur in the whole lower sequence and by means of them the whole lower sequence and by means of them the separate "oscillation" period of F. BARTHA, [1971*a*, *b*, 1974, 1975] cannot be distinguished. His Upper Pannonian is wider in time than that of us since it includes our "Upper Pliocene", too, as the uppermost member of the substage. On the contrary, our uppermost member may correspond to the lower part of the upper sequence of the classification of the marginal parts quoted above.

SUMMARY

The exact classification of the intrabasin Pannonian sequences of great thickness as well as their correlation with the marginal areas are unsolved till now. This can be explained partly by the incomplete knowledge of the intrabasin areas caused by sparse core sampling, partly by facies differences. In different basin parts of the Pannonian inland lake petrologically different sediments were deposited simultaneously. The thickness of the sediments was determined first of all by the changing rate of the subsiding movements of the basement and of the areally changing filling up. Since the fauna followed the changes of lithofacies in general, the individual fauna assemblages appeared or extincted in different areas by certain time delay. Consequently, especially from the Upper Pannonian the fauna indicates rather environment than age. Consequently, considerable faunistical differences developed between the single basin parts and often the generations also differ. The picture given on the Algyő area can be only outlined and cannot be regarded complete.

I. 1. In most of the bores the Lower Pannonian substage has four lithofacies overlying each other and out of which the lower three may replace each other laterally. Thus, the different occurrences of the same lithofacies are by no means contemporaneous.

2. After the accumulati onof the transgressive basal conglomerate surrounding ring-likely the Algyő island, somewhat deeper marls and lime marls developed as a result of the relatively faster subsidence of the basement, which spread horizontally over the coarse clastic sequence. In this phase the subsidence is faster than the filling up.

3. The clay marl sequence is the first complex which is commonly widespread. The water table reached its greatest extension at that time. The rate of filling up falls behind the subsidence.

4. The sandstony sequence is the thickest and most explored strata series which consists of thicker strata in the lower and thinner rhythms in the upper part, in general. The lower part is characterized by slower subsidence and faster filling up while the upper part can be characterized by the nearly same rate of subsidence and filling up.

5. The Lower Pannonian of Algyő cannot be recently satisfactorily classified from the biostratigraphic point of view. Regarding only the fauna the stage seem to be trisected. Only a rough correlation is possible with formations of the marginal parts.

II. 1. The Upper Pannonian overlies the Lower Pannonian by angular discordance; its lower boundary can be marked lithologically (on the basis of electric profiles) just due to its more sandy composition.

2. From the beginning of the Upper Pannonian the filling up had been of considerable measure, so that in addition to the shallow lacustrine environments marshy and bog environments should also be taken into consideration. These follow one another spatially beside, temporally above each other.

3. Partly on faunistical and partly on lithological bases the Upper Pannonian has been divided into a lower, middle and upper sequence which, however, cannot be exactly correlated neither with other intrabasin, nor with other marginal formations.

4. The lower sequence is characterized by the predominance of the shallow lacustrine environment, though the role of marshy and bog environments

is also important. Thinner woody brown-coal strips occur already at the bottom of the sequence. The high-grade mixing of the Upper and Lower Pannonian types is characteristic of its fauna composition. In addition to the extreme dominancy of the *Limnocardium abichi* (R. H.) *var.* and to other forms spreading from the Lower Pannonian numerous species being later of increased importance occur which are characteristic only of the Upper Pannonian. This sequence is nearly contemporaneous with thel marginal horizons of ungulacaprae — rhomboidea — auricularis as wel as with that of subglobosa of Transdanubia.

5. The middle sequence is lithologically characterized by the appearnce and in the upper section by the predominance of the woody brown-coal strata. The Pannonian inland lake became shallow and was separated into smaller parts. The marshy environment becomes most significant. The most frequent species are the *Viviparus sadleri* (PARTSCH), the *Dreissena serbica* (BRUS.) and the *Limnocardium vutskitsi* (BRUS.). The middle sequence of Algyő can be correlated only in part with the marginal horizons of "balatonica" and "oscillation", this latter one being of wider time extension. The sequence cannot be divided into the "balatonica" and "oscillation" phases. As against the oscillation the gradual filling up is characteristic.
6. At the time of accumulation of the sediments of the upper sequence the filling up had been of considerable size so that the fluviolacustrine environments predominated. The Pannonian inland lake essentially ceased. The sequence cannot be correlated with the upper member of the marginal classification.

REFERENCES

BARTHA, F. [1971*a*]: A magyarországi pannon biosztratigráfiai vizsgálata. — In: A magyarországi pannonkori képződmények kutatásai. pp. 9—172, Budapest (In Hungarian).

BARTHA, F. [1971*b*]: Die Stratotypen des Pannons. — Földt. Közl., **101**, pp, 160—161.

BARTHA, F. [1974]: The Problems of the Pannonian of Hungary. Acta Miner. Petr. Szeged, **21**, 2, pp, 282—301.

BARTHA, F. [1975]: Horizontale und vertikale Verbindungen der Pannonablagerungen von Ungarn und Ihre Problematik. — Földt. Közl., **105**, pp. 399—418, Budapest.

DANK, V. [1965]: Deep-structural patterns of the Neogenic basin portions of the southern Great Plain and their relation to the areas of South Baranya and Yugoslavia. — Földt. Közl., **95**, pp, 123—139, Budapest.

JÁMBOR, Á., KORPÁS-HÓDI, M. [1971]: Stratigraphische Horizontierungsmöglichkeiten in den Pannonablagerungen im Südost — Vorland des Transdanubischen Mittelgebirges. — MÁFI Évi Jel., 1969, pp, 155—191, Budapest.

JASKÓ, S. [1966]: A Középdunai pliocén medence lignittelepeinek térbeli elterjedése és rétegtani szintezése. — Földt. Kut., **9**, 1, pp, 3—9, Budapest (In Hungarian).

T. KOVÁCS, G. [1973]: Das Miozän im Südteil des Donau—Theiss-Zwischenstromlandes. — Földt. Közl., **105**, pp, 220—236.

KŐRÖSSY, L. [1968]: Entwicklungsgeschichtliche und paläogeographische Grundzüge des ungarischen Unterpannons. — Acta Geol. Ac. Hung. **12**, pp, 199—217, Budapest.

KŐRÖSSY, L. [1971]: Mélyföldtani és fejlődéstörténeti vázlatok a magyarországi pannonból. — In: A magyarországi pannonkori képződmények kutatásai. pp, 199—223, Budapest (In Hungarian).

KŐVÁRY, J. [1956]: Thecamoebions (Testacées) des sediments du Pannonien inférieur de la Hongrie. — Földt. Közl. **86**, 3, pp, 266—273.

KŐVÁRY, J. [1973]: Szénhidrogénkutató fúrások által Kelet- és Délkelet-Tiszántúlon feltárt neogén tengeri üledékek mikrobiofácies vizsgálata. — (Manuscript; in Hungarian).

MOLNÁR, B. [1963]: Gliederung der pliozänen und pleistozänen Ablagerungen des südlichen Teiles der Grossen Ungarischen Tiefebene auf Grund der Zusammensetzung der Schwermineralien. — Földt. Közl., **98**, 1, pp, 97—117.

MUCSI, M. [1973]: Geological history of the southern Great Hungarian Plain during the late Tertiary. — Földt. Közl., **103**, 3—4, pp, 311—318.
MUCSI, M, RÉVÉSZ, I. [9175]: Neogene evolution of the southeastern part of the Great Hungarian Plain on the basis of sedimentological investigations. — Acta Miner. Petr. Szeged, **22**, 2, pp. 29—49.
PAUCA, M. [1967]: Problems of Pliocene Pannonian Facies Rumania. — Bull. Amer. Ass. Petrol. Geol., **51**, 5, pp, 686—704, Tulsa.
SOMFAI, A. [1970]: Examination of overpressure reservoirs in the southern Great Hungarian Plain: a classification of the causes of overpressure. — Acta Miner. Petr. Szeged, **19**, 2, pp, 173—184.
STEVANOVIC, P. M. [1959]: Pont (i. eng. S.) im nördlichen Jugoslavien sein Fazies und Horizonte, mit einem Rückblick auf die Verhältnisse in den Nachbarländern. — Földt. Közl., **89**, 1, pp, 9—15.
SZABÓ-KILÉNYI, É., SZÉNÁS, GY. [1971]: A pannonkori képződmények geofizikai vizsgálata. — In: A magyarországi pannonkori képződmények kutatásai. pp. 224—232, Budapest (In Hungarian).
SZÉLES, M. [1962]: Molluscenfaunen von Beckensedimenten des Unterpannons. — Földt. Közl., **92**, 1, pp, 53—60.
SZÉLES, M. [1966]: Paläontologische Beiträge zur Abgrenzung des Unter — und Oberpannons. — MÁFI Évi Jel. **1964**, pp. 559—568.
SZÉLES, M. [1968*a*]: Pliozänablagerungen im Südteil der Grossen Ungarischen Tiefebene. — Földt. Közl., **98**, 1, pp, 55—66.
SZÉLES, M. [1968*c*]: Az alföldi szénhidrogénkutató fúrások által feltárt pliocén képződmények rétegtani és őslénytani értelmezése. — OGIL-kiadvány. Budapest (In Hungarian).
SZÉLES, M. [9171]: A Nagyalföld medencebeli pannon képződményei. In: A magyarországi pannonkori képződmények kutatásai. pp. 253—345, Budapest (In Hungarian).
SZÓNOKY, M. [1975]: Medenceperemi és medencebelseji felső-pannoniai rétegsorok összehasonlító vizsgálata. — (Manuscript; in Hungarian).
TÓTH, K. [1971]: A Vértes-hegység délkeleti előterének pannon képződményei. — In: A magyarországi pannonkori képződmények kutatásai. pp, 345—361, Budapest (In Hungarian).
VÖLGYI, L. [1965]: Geological studies of the deepstructural features of the central parts of the Great Plain .— Földt. Közl., **95**, 2, pp, 140—163.
VÖLGYI, L., BALLA, K., SUBA, S., CSALAGOVITS, I. [1970]: Magyarország szénhidrogéntelepei. Algyő. — OKGT-kiadvány (In Hungarian).

Manuscript received, August 15, 1976

LÁSZLÓ MAGYAR
OKGT, NKFÜ
H-6701 Szeged, Pf. 30, Hungary
ISTVÁN RÉVÉSZ
OKGT Research Laboratory
for Oil and Gas Industry
H-6701 Szeged, Pf. 30, Hungary