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Gavelinella Brotzen, 1942 and Lingulogavelinella Malapris,1969 (Foraminifera) from the Bohemian Cretaceous Basin

Gavelinella Brotzen, 1942 a Lingulogavelinella Malapris, 1969 (Foraminifera) z české křídové pánve

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Abstract: The presented paper deals with a detailed study of two related foraminiferal genera *Gavelinella* BROTZEN, 1942 and *Lingulogavelinella* MALAPRIS, 1969 from the Bohemian Cretaceous Basin. Apart from the revision of the taxonomic classification of species, attention has been paid to the phylogenetic evolution of the group, paleoecology and paleogeography of gavelinels in the Bohemian Cretaceous Basin, with consideration about both favourable and unfavourable living conditions which may influence the evolution of the species. The stratigraphic range of individual species in the Bohemian Cretaceous Basin is compared with that in German-Polish and Anglo-Paris Basin.

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Genera *Gavelinella* BROTZEN, 1942 and *Lingulogavelinella* MALAPRIS, 1969 form a significant component of Upper Cretaceous foraminiferal assemblages not only in the Bohemian Cretaceous Basin but even in Cretaceous basins of some other European areas.

Broad vertical and horizontal range of the *Anomalinidae* family representatives attracted attention of many paleontologists as early as in 19th century when MONTFORT (1808), D'ORBIGNY (1826), REUSS (1845-1846, 1851) and others, managed to divide the genera *Anomalina, Cibicides* and *Planulina*, in consideration of the chamber growth style and chamber shape. Nevertheless, in the course of time, varios forms were interpolated within the group which resulted in various problems in the classification. Some paleontologists, for example, classified the above mentioned species within the new *Rotalidae* family, introduced by REUSS in 1860.

Later, representatives of these genera were classed with the family *Anomalinidae*, described first by CUSHMAN (1928) which divided these foraminifera, according to aperture location, shape and convexity of tests, into the subfamilies *Anomalininae* and *Cibicidinae*. Subsequently, BROTZEN (1942) and GLAESSNER (1942) studied in details the aperture and umbilicus of *Anomalina* representatives and, based upon their results, set new genera such as *Gavelinella, Pseudovalvulineria* and *Cibicidoides*. The first two genera were included into the subfamily Valvulinerinae whilst the last one to the subfamily Cibicidinae.

The position of the genus *Anomalina* has been often discussed because of the lack of important features in the description of typical species (the original of D'ORBIGNY is not probably preserved). Issuing from the study of the type locality, the name *Anomalina* has been restricted to Recent genera only, based on the original description and illustration, and separated from the genus *Anomalinoides* with the range Upper Cretaceous-Recent. Within the *Anomalinidae* family we include also the genus *Gavelinella* which is frequent throughout the Cretaceous.

VASILENKO (1954) modified somewhat the original Cushman's classification and accepted the form family under a different view. In contrast to CUSHMAN and BROTZEN she introduced, aside from the others, also new subgenera *Gavelinella* and *Pseudovalvulineria*, which affixed to the family *Anomalinidae*. According to the mentioned author, the main feature of the subgenus *Gavelinella* are the connected chambers of all whorls of the test, with umbilicus covering the aperture, which is elongated and extended, as a narrow slit, towards the ventral test side. The inner margin of the chambers is formed by short projections in the umbilicus area. This division of the genus Anomalina into several subgenera has been applied by some Russian and Bulgarian authors (VAPCAROVA 1971 and others).

A new genus *Lingulogavelinella* MALAPRIS, related to *Gavelinella* BROTZEN, 1942 was established in 1965.

Most authors follow the classification of LOEBLICH and TAPPAN (1964, 1974), which is also accepted in the present work and abandon the use of subgenera introduced by Vasilenko. The division into subgenera and subspecies can be explained by sexual dimorphism of individuals.

The group of gavelinels from the Bohemian Cretaceous Basin has not been subjected to modern studies yet.

Therefore, the main effort was directed to the systematic revision of species together with an introduction to the theory of phylogenetic evolution of both species in the Bohemian Cretaceous Basin, with respect to some observations made in the German-Polish and Anglo-Paris Basin (MICHAEL, 1966; GAWOR-BIEDOWA, 1972; CARTER and HART, 1977; EDWARDS, 1981). At the same time, an attempt to interpret the origin and taxonomic importance of the individual species in the Bohemian Cretaceous Basin was made.

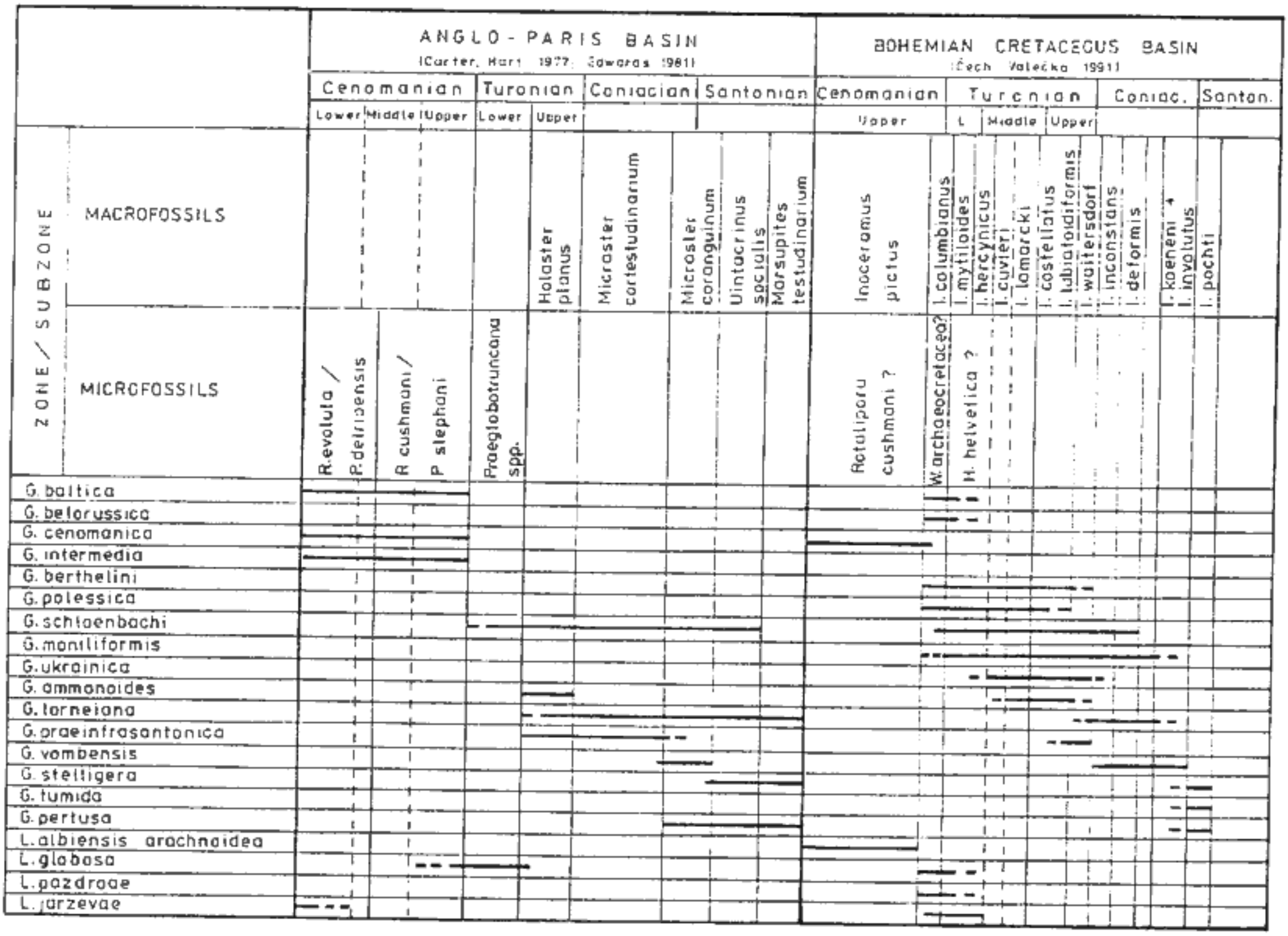
A great attention has been paid to the ecology and paleogeography of the cited group in the Bohemian Basin. Some factors, as the character of sediment and water depth, might have influenced the *Gavelinella* distribution as well as the modification of the test dimensions of the individuals.

The stratigraphic significance of gavelinels

The genus *Gavelinella* is widespread from the Cretaceous to Miocene whereas the genus *Lingulogavelinella* Malapris is limited only to the Cretaceous. The representatives of gavelinels are know from both Americas, from Australia and New Zealand. In Europe, species of this group have been described from the Upper Cretaceous of Russia and Bulgaria, from NW Germany, Poland, France, England and other localities. Generally, gavelinels are widespread in Upper Cenomanian and Lower Turonian sediments, where form, together with planktonic foraminifers, an important constituent of the Foraminifera assemblage. This is why some authors refer gavelinels to benthonic species, as the part of the Foraminifera planktonic assemblages mostly on the Cenomanian Turonian boundary. FRIEG (1986), for example, introduced also the species of *Gavelinella baltica* as a dominant one, within his characteristics of the *Rotalipora cushmani* Zone (Cenomanian); in addition also *G. cenomanica, G. belorussica, L. globosa* and *L. formosa.* Also, he noted significant species in the of *Whiteinella archaeocretacea* Zone (Lower Turonian): *G. baltica, G. cenomanica* and *L. globosa.* According to CARTER and HART (1977) the gavelinels are a constituent of some foraminiferal zones, above all in the areas where the occurrence of foraminifers decreases. These authors studied also the benthic zonal schemes, in addition to planktonic ones, which are based upon the most important evolution lines *Arenobulimina - Flourensina* (Albian-Cenomanian) and *Gavelinella - Lingulogavelinella* (Cenomanian).

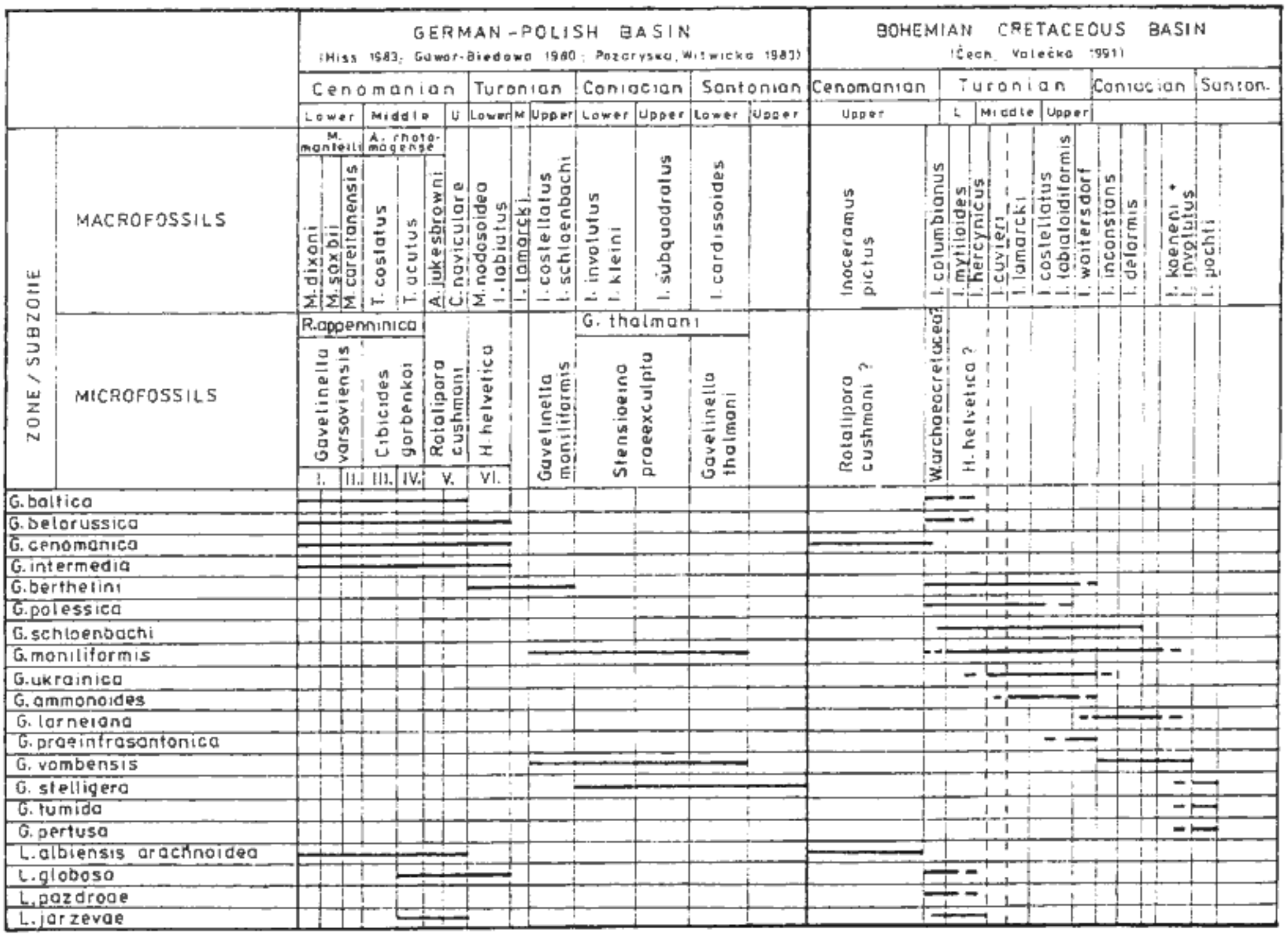
The species of the *Gavelinella* genus occur in the Bohemian Cretaceous Basin within all the stratigraphic levels. Some species of this group are valid dominant ones whereas others, more dependent upon facial evolution of

Table 1. Distribution of gavelinels and the stratigraphic correlation of the Bohemian Basin with the Anglo-Paris Basin



a certain area, play only local role. In the Bohemian Massif, the marine sedimentation started in the Cenomanian, continuing till the Lower Santonian when a regional regression occurred.The oldest marine sediments are believed to be the Upper Cenomanian sandstones, calcareous siltstones and silty claystones which contain, beside the agglutinated foraminifers, mostly typical dominant species of *Gavelinella cenomanica*. These geographically widespread species are known from some Cretaceous formations of Europe (NW and central Poland, NW Germany, Anglo-Paris Basin etc.), being described here within the planktonic foraminiferal zones of *Rotalipora cushmani* and Whiteinella archaeocretacea. An important constituent of the Foraminifera assemblage along the Cenomanian/Lower Turonian boundary in the Bohemian Cretaceous Basin are the representatives of *Lingulogavelinella*. This genus reached its maximum prime in the Lower Turonian. Together with *Lingulogavelinella*, in the foraminiferal assemblage also appear *G. belorussica, G. baltica* and *G. polessica*. We can correlate this range in the Bohemian Cretaceous to some regions in the Anglo-Paris Basin. According to Carter and HART (1977), in the region of Denver the gavelinels dominate also in the Upper Cenomanian and along the Cenomanian/Turonian boundary, where *Lingulogavelinella globosa* var. *convexa* moreover occurs. In this region, the zone 14/1 - Upper Cenomanian is the area of maximum extension of this species. *G. baltica* is believed to have the widest stratigraphic range in the German-Polish Basin, where Frieg (1986) reported its occurence as high as the Middle Turonian (*Marginotruncana coronata* Zone), together with *G. cenomanica*. In the Bohemian Cretaceous Basin, *G. cenomanica* is restricted only to the Upper Cenomanian (*Rotalipora cushmani* and *Whiteinella archaeocretace* Zone) whilst *G. baltica* passes up to the Lower Turonian and may reach of *Helvetoglobotruncana helvetica* Zone. During the Turonian, another species of *Gavelinella* appeared in the Bohemian Cretaceous Basin. Nevertheless, their distribution strongly depends on the facial zonations of the environment. Thus, *G. ammonoides* appeared on the Middle Turonian in the central, deepest part of the Bohemian Cretaceous Basin. This species is frequent in the Upper Turonian and Lower Coniacian sediments in the western area of the basin, between the towns of Teplice and Ústí nad Labem. Similarly, another species such as *G. berthelini, G. monoliformis, G. ukrainica, G. schloenbachi* are very sensitive to the depth of the sea as well as to the lithology of sediments. The beginning of the Coniacian was characterized in all Central European regions, by the enrichment of foraminiferal fauna with several new *Gavelinella* species such as *G. lorneiana* and *G. vombensis*

Table 2. Distribution of gavelinels and the stratigraphic correlation of the Bohemian Cretaceous Basin with the German-Polish Basin



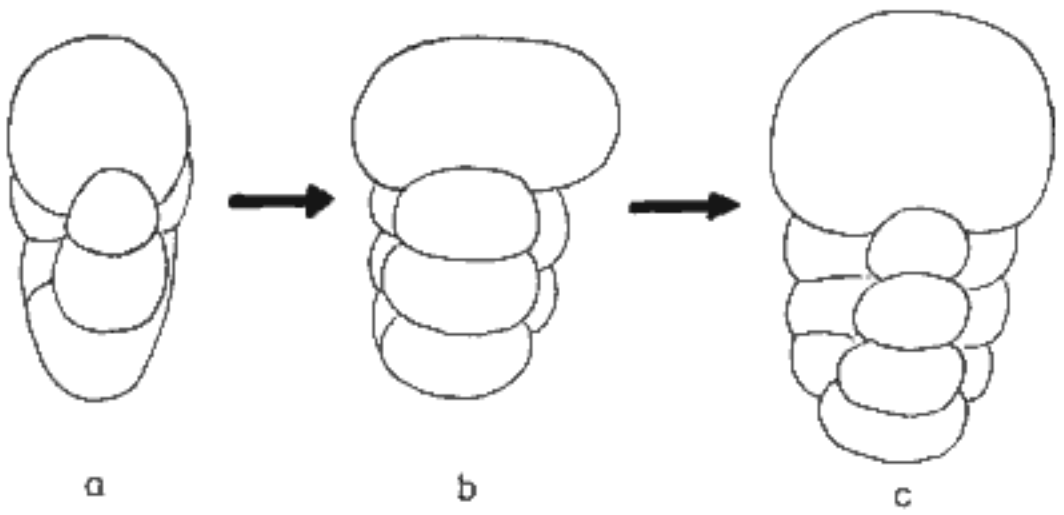
sis. EDWARDS (1981) reported the appearance of *G. lorneiana* from the Upper Turonian of NW Europe *(Holaster planus* Zone), and the appearance of *G. vombensis* from the upper part of the *Micraster cortestudinarium* Zone (Lower to Upper Coniacian) up to the upper part of the *Micraster coranguinum* Zone (Upper Coniacian-Lower Santonian). According to this author, *G. vombensis* is very important because it defines the lowermost part of the Santonian. The stratigraphically uppermost occurence of *G. vombensis* is thus an indicator of the Coniacian/Santonian boundary toward the uppermost level of the *Micraster coranguinum* Zone. The following important change in the foraminiferal benthonic assemblage of the Bohemian Cretaceous Basin, associated with the Coniacian-Santonian boundary, consist in reappearance of the species like *G. stelligera, G. pertusa* and *G. tumida*. These species first appeared in the Lower Santonian sediments also in other European units (Anglo-Paris Basin).

We can conclude that gavelinels, in spite of their wide stratigraphic distribution and relatively rich occurence, cannot be fully employed for the detailed stratigraphic zonation of the Upper Cretaceous since they can be strongly influenced by the facial variations of the environment. Another congent reason for this statement is their considerable intraspecies variability which can be supported by the existence of many synonyms, causing certain problems for species determination.

Outline of phylogenesis of gavelinels in the Bohemian Cretaceous Basin

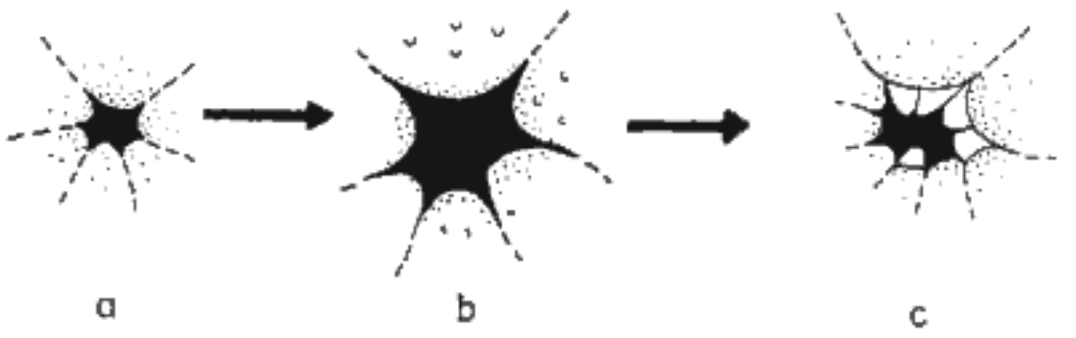
Evolution of the gavelinels from the Bohemian Cretaceous Basin can be more or less compared to that of the gavelinels from the German-Polish sedimentary basin. According to MICHAEL (1966), during the gavelinels phylogenesis within the Lower-Upper Cretaceous period, the older, more asymmetric forms of tests tend to grow into bilaterally symmetrical ones, with involute spiral side. In some evolutionary lineages, characteristic sculptures on the test surface are developed during their phylogenesis,such as glassy discus, hook-like thickenings, which probably served as a protection of inner, weaker coilings. In many cases, the umbilical depressions on the ventral test sede used to be frequently covered by the proximities of chamber parts or by elongated thickened septal sutures (*G. vombensis)*, during the individual evolution.

To interpret the phylogenetic evolution of gavelinels in Upper Cretaceous formations of the Bohemian Massif, the author followed the outline of Lower Cretaceous species evolution (HRADECKÁ 1987b) as it was introduced by MICHAEL (1966) and CARTER and HART (1977), as well as the model of stratigraphically younger species as outlined by EDWARDS (1981). Some of their evolutionary lineages were completed here by new members. Into the evolutionary lineage of *G. ammonoides - G. lorneiana - G. pertusa,* I have included another one, *G. baltica,* considering it the oldest member of this row, based on the morphological similarity of the test. However, to the evolutionary lineage *G. schloenbachi - G. praeinfrasantonica - G. vombensis, G. stelligera* is newly added due to the starlike arrangement of thickness in central part of ventral test side.



1. Evolutionary changes in the last whorl of the test. a - *G. polessica*, b - *G. moniliformis*, c - *G. tumida*

Based on the supposed evolution of Lower Cretaceous gavelinels from *G. rudis*, which was introduced by Michael, the evolutionary lineage *G. polessica - G. moniliformis - G. ukrainica - G. tumida* was newly compiled which is valid for the form with nearly sphaerical chambers in the last whorl. The morphological diversities of species test of this evolutionary lineage are caused by the convexity of chambers in the last whorl which was enlarged during the phylogenesis. The sutures between the chambers became more expressive and concave (text-fig. 1). During the evolution, the umbilicus was widened and the test became generally more coarse, bearing the impressive pores on both the ventral and dorsal sides. In evolutionary younger foraminifers of this lineage (*G. tumida*), a wider umbilicus is partly covered by projections of proximal parts of chambers (text-fig. 2).



2. Evolutionary changes in the umbilical part on the ventral side of the test. a - *G. polessica*, b - *G. moniliformis*, c - *G. tumida*

Into the evolutionary lineage of *Lingulogavelinella* as established by CARTER and HART (1977), I included here also *L. pazdroae* described from the Polish Cretaceous (GAWOR-BIEDOWA,1972).

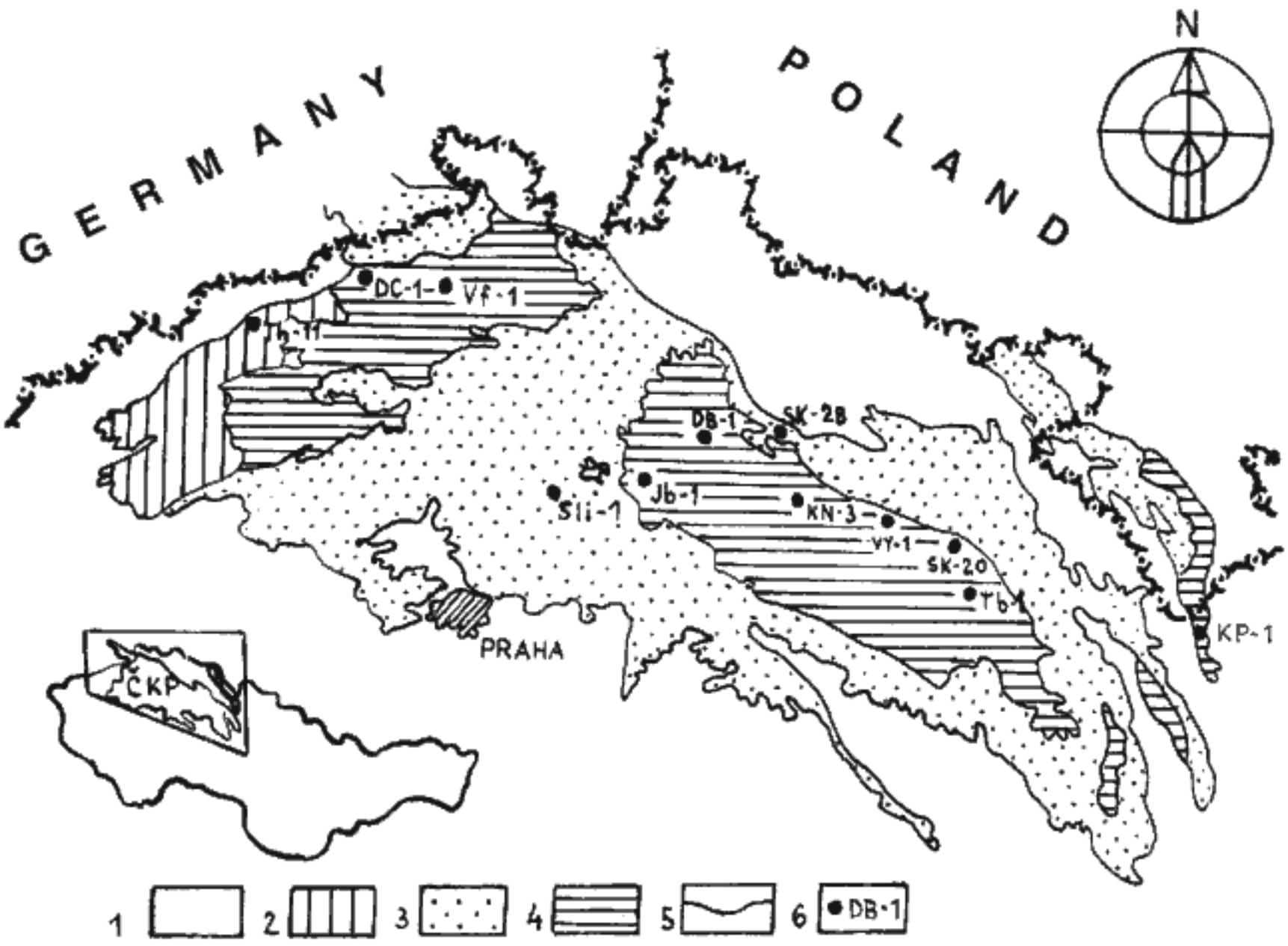
Notes on the paleoecology of gavelinels in the Bohemia Cretaceous Basin

Ecology of fossil representatives of *Gavelinella* and *Lingulogavelinella* has remained relatively unsatisfactorily understood until now. Relation between test morphology and living conditions during their evolution has already been proved (PHLEGER 1966, BRADSHAW 1959).

Gavelinels, like other benthic organisms living on the bottom of the sea, were influenced by changed of physical, chemical and paleontological factors, such as depth and temperature of water, salinity and nature of the sea bottom. Therefore, I attempted here to find out how some gavelinels respond to certain life environment factors (e.g. type of sediment, local deepening and shallowing of the basin - tab. 3). Also, variations of living conditions in relation to test dimensions of the studied species have been examined here. The gavelinels assemblage was obtained from thirteen chosen boreholes located roughly parallel to the main axis of the basin. All the boreholes were drilled through as complete stratigraphic sequences of Upper Cretaceous sediments as possible. Various facies transitions and rich assemblage of foraminifers were supposed too (text-fig. 3). Variations of test dimensions might be conditioned by species evolution, however, within a certain time-span only one generation could preferentially evolve as a result of favourable living conditions. According to BRADSHAW (1957) and PHLEGER (1960) the microspheric individuals (assexual) bearing a larger adult test prevail in less favourable conditions whilst the wider distribution of macrospheric sexual generation with small adult test suggets more favourable conditions. Hence, large populations of small tests are not indicative for impoverish fauna but, on the contrary, they can prove the unusually advantageous life conditions and easy reproduction (PHLEGER, 1960).

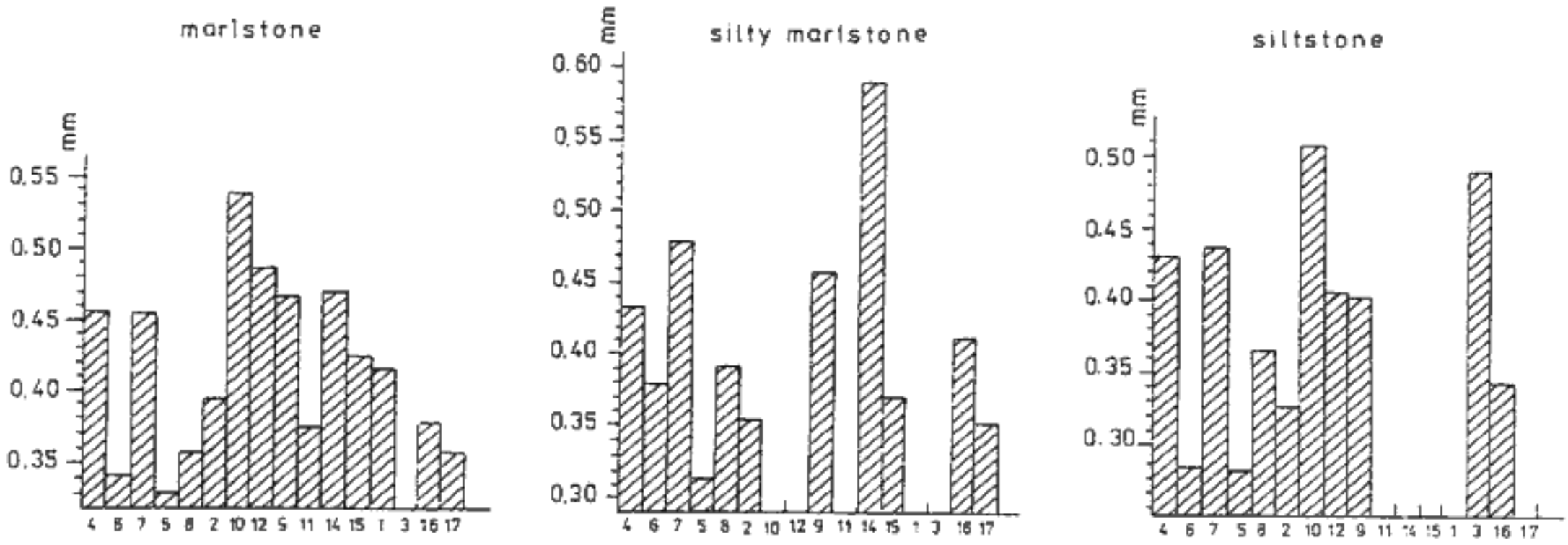
Gavelinella berthelini has a wide stratigraphic distribution from the Upper Cenomanian to the Coniacian. It is present in all basic types of sediments. In spite of its relative abundance, the distribution of this species in the Bohemian Cretaceous of the Upper Cenomanian of the so-called "plenus zone" in the centre of the basin. During the Lower and Upper Turonian however, it belongs here among the most abundant species while in marginal parts of the basin it is either missing or rare. Thus, we can suggest that this species required relatively deeper-sea conditions with calm water although it could survive also in locally shallower parts of the basin. This can be supported also by the prevalence of percentual content of macrospheric generation in the Lower Turonian, since favourable conditions enabled its extension. Beginning from the end of the Lower Turonian the life conditions for this species aggravated which is indicated by abundant microspheric tests of the population. Successively, this species became extinct in the Coniacian of the Bohemian Cretaceous Basin. It is very frequent in Upper Turonian sediments in the western part of the basin between Teplice and Děčín were it reaches up to the Lower Coniacian.

Gavelinella schloenbachi has also wide stratigraphic range in the Bohemian Cretaceous Basin - from the Lower Turonian to the Coniacian. A study in chosen boreholes within all stratigraphic levels documents the domination of microspheric tests. This species is most abundant in the Lower Turonian and Coniacian. Based on the presence of both generations we can suggest that exceptionally favourable conditions prevailed in the Middle Turinian where the rate of both generations is nearly equal. *G. schloenbachi* is present throughout all types of sediments except for



3. Location of the studied boreholes (after Čech 1987, modified). 1 - Pre-Cretaceous rocks, 2 - Cretaceous formations covered by younger (Tertiary) sediments, 3 - Peruc-Korycany Formation to Jizera Formation (Cenomanian to Upper Turonian), 4 - Teplice Formation and Březno Formation (Upper Turonian-Santonian), 5 - bordering of the Bohemian Cretaceous Basin, 6 - the boreholes studied

Table 3. Size of the tests of gavelinels related to the character of the sediment. *1 Gavelinella baltica, 2 Gavelinella belorussica, 3 Gavelinella cenomanica, 4 Gavelinella berthelini, 5 Gavelinella polessica, 6 Gavelinella schloenbachi, 7 Gavelinella moniliformis, 8 Gavelinella ukrainica, 9 Gavelinella ammonoides, 10 Gavelinella lorneiana, 11 Gavelinella praeinfrasantonica, 12 Gavelinella vombensis, 14 Gavelinella tumida, 15 Gavelinella pertusa, 16 Lingulogavelinella globosa, 17 Lingulogavelinella pazdroae*



clayey limestones and limestones. In the Middle Turonian siltstones of the central basinal part east of Mladá Boleslav the smallest tests have been measured. On the contrary, the largest tests were found in the same area, within silty sandstones, sandstones and marlstones of the Lower and Middle Turonian. It can be therefore suggested that *G. schloenbachi* probably responded to the lithologic changes. In the Lower and Middle Turonian it appears often together with the shallow-water species *Cassidella tegulata* (REUSS), *Vaginulina recta* REUSS, *Vaginulina robusta* (CHAPMAN); during the Lower Coniacian it is rare owing to deepening of the basin.

Gavelinella moniliformis had probably most favourable conditions for its development during the Lower and Middle Turonian. It follows from the percentual content of individuals of both generations in the boreholes studied. The largest tests are in the silty marlstones and marlstones of the Coniacian while the smallest in the sandstones to silty sandstones of the Middle Turonian. From this observation it can be judged that local shallowing of the basin during the Middle Turonian, characterized by silty sandstones to sandstones with better oxygenated water, was favourable for the development of this species, too. The species became rare in the Coniacian when the sea was deepening.

Gavelinella polessica belongs to species with wide stratigraphic range in the area of the Bohemian Cretaceous Basin. The prevalence of microspheric tests which indicated less favourable conditions for the species development was found in all stratigraphic levels of the boreholes studied. Differences of test dimensions during the evolution are small. The smallest dimensions, on the average, were noted in the Lower Coniacian and the largest ones in the Middle Turonian species. *G. polessica* was found too, in all basic types of sediments except for silicified silty to calcareous claystones.

Gavelinella belorussica appears first in Upper Cenomanian silty sediments in the central part of the Bohemian Cretaceous Basin in the "plenus zone". The main expansion of this species begins in the Lower Turonian and by its end it dies out. This species was found in all types of sediments with the exception of sandstones. The largest dimensions of tests are in marlstones and silty marlstones. G. *belorussica* is found, above all, in boreho-

les of the central part of the basin between Mělník and Hradec Králové, i.e. in a relatively deeper part of the Cretaceous sea, whereas it is missing in marginal regions of the basin. That in deeper and calmer parts of the basin the conditions for the development of the species were favourable, which can be proved by the prevalence of macrospheric individuals in the population.

Gavelinella ukrainica appears first in sandly-silty sediments of the Middle Turonian in the central part of the basin and simultaneously in the NW part of the basin around Děčín. Tests have the smallest dimensions in Upper Turonian and in silicified, silty to calcareous claystones of the Lower Coniacian.

Gavelinella lorneiana was found in the Lower and Upper Coniacian (in marlstones and siltstones) in the Bohemian Cretaceous Basin. This species is more widespread especially in the NE part of the basin. We can suppose, from the representation of microperic generation in the population, that during the Coniacian the conditions were less favourable for this species.

Gavelinella vombensis the same as *G. lorneiana* is restricted to siltstones and marlstones of the Lower and Upper Coniacian. It was found, for the first time, in eastern Bohemia but also in western part of the Bohemian Cretaceous Basin around Teplice. It can often be found together with *Stensioeina exsculpta* (REUSS) and *S. granulata* (OLBERTZ) which indicate the deepening of the basin.

Gavelinella praeinfrasantonica was found only in boreholes passing the Upper Turonian marlstones in the central part of the basin and in marlstones NW of Hradec Králové and around Teplice. Generally, in the foraminiferal association this species is represented only scarcely.

Gavelinella ammonoides was firstly found in siltstones and marlstones of the Middle Turonian in the centre of the Bohemian Cretaceous Basin. In western Bohemia it occurs until the Upper Turonian and in the facies of silty marlstones it reaches up to the Lower Coniacian. Gradual increasing of silty admixture leads to the reduction of the test of this species.

Gavelinella baltica is restricted to the marlstones and clayey limestones of the Lower Turonian, where it has smaller dimension of tests in clayey limestones. The first isolated occurrences of this species were noted in the uppermost part of the Cenomanian in the central part of the basin. *G. baltica* preferred probably relatively deeper and calmer areas of the Cretaceous sea.

Gavelinella cenomanica is ubiquitous in siltstones of the Upper Cenomanian where it represents the main component of the population. The species tests have smaller dimensions in clayey limestones.

Gavelinella tumida and *Gavelinella pertusa.* Both species we have found only in Santonian marlstones to silty marlstones in some boreholes of the western part of the Bohemian Cretaceous Basin. *G. tumida* has smaller tests in marlstones as compared with *G. pertusa* which probably was more developed in the environment with silty admixture.

Lingulogavelinella globosa and *Lingulogavelinella pazdroae.* Both species are the main component of the Lower Turonian foraminiferal association. They were found occassionally also in the uppermost Cenomanian, mostly in central part of the basin. *L. pazdroae,* which is less abundant, occurs only within two lithologic types - marlstones and silty marlstones in the central part of the basin close to Hradec Králové. In both types of sediments the tests are nearly equal. *L. globosa* is more abundant also in other types of sediments. The smallest tests were found in clayey limestones while the largest ones in marlstones. This species enjoyed favourable life conditions mainly on calcareous and silty sediments of relatively deeper sea. This can be supported also by the predominance of macrospheric tests in the population.

Systematic part

Suborder *R o t a l i i n a* DELAGE and HÉROUARD, 1896

Superfamily *N o n i o n a c e a* SCHULTZE, 1854

Family *G a v e l i n e l i d a e* HOFKER, 1956

Genus *Gavelinella* BROTZEN, 1942
Type species: *Discorbina pertusa* MARSSON, 1878

Gavelinella cenomanica (BROTZEN, 1942)
Pl. I, figs. 1-5, 8

1942 *Cibicidoides* (*Cibicides*) *cenomanica* BROTZEN; BROTZEN, 54, pl. 2, figs. 2a-c.
1954 *Anomalina* (*Pseudovalvulineria*) *cenomanica* var. *cenomanica* VASILENKO; VASILENKO, 80, pp. 87/88, pl. 9, figs. 1a-c, 2a-c.
1957 *Gavelinopsis cenomanica* (BROTZEN); HOFKER, 321, text-fig. 370.
1959 *Anomalina cenomanica* (BROTZEN); MASLAKOVA, p. 100, pl. 5, fig. 5a, b, v.
1961 *Anomalina* (*Pseudovalvulineria*) *cenomanica* (BROTZEN); VASILENKO, pp. 116, 119, pl. 21, fig. 6a, b, v.
1966 *Anomalina cenomanica* BROTZEN; ALEXANDROWITCZ, p.89, fig. 35.
1971 *Pseudovalvulineria cenomanica* BROTZEN; ALEXANDROWITCZ, p. 325, figs. 3a-c, 4.
1972 *Gavelinella* (*Gavelinella*) *cenomanica* (BROTZEN); GAWOR-BIEDOWA, pp. 126-128, pl. 17, fig. 4a-c.
1974 *Gavelinella cenomanica* (BROTZEN); HERCOGOVÁ, p. 94, pl. 8, fig. 2a-c, text-figs. 5-7.

Type species is deposited in the collection of the Swedish Geological Survey, Stockholm, and is derived from the borehole II, Höllviken, Scania, Sweden, 1, 190 mts, Cenomanian.

Description: test biconvex, oval, with narrow, somewhat rounded margin, and even in outline. The last whorl is composed of nine to twelve chambers. On the dorsal side chambers are flat, trapezoidal, divided by subradial, convex sutures. Wide and apically frayed ridge is developed along the thickened spiral suture. On the ventral side, the chambers in the initial part of the whorl are triangular, flat, in the terminal part more convex. Septal sutures thickened, wide. Umbilicus narrow, shallow, surrounded by lamellar flaps of the last chambers. Apertural surface triangular, flat or sometimes slightly convex; aperture semilunar, surrounded by a fairly thick lip. The test of mic-

rospheric individuals is composed of three whorls with a total of 24-26 chambers, 11 to 12 of them in the last whorl. The diameter of the proloculus reaches 26,0 to 27,0 μm. The test of macrosperic individuals is composed of two whorls with a total of 16-18 chambers, the last whorl is composed of 9 to 11 chambers. The diameter of the proloculus amounts 48,0 to 50,0 μm.

Remarks: in the sediments of the Bohemian Cretaceous Basin a multitude of individuals of this species was faund. All of them completely respond to the original description of the species. The individual variability concerns the shape and size of tests, width and thickness of sutures, the shape of apertural surface and degree of fraying of the ridge on the spiral suture. *G. cenomanica* has broad horizontal distribution and small stratigraphic range. This species is supposed within index fossil in the Upper Cenomanian.

Distribution: Anglo-Paris Basin - *H. delrioensis/H. infracretacea Zone* (Cenomanian); Germany (Ruhr district) - Albian, Cenomanian (*R. cushmani, W. archaeocretacea* Zones) and the base of *M. mucronata* Zone (beginning of the Middle Turonian); Konsk-Jalinsk basin and the margin of Donbas (USSR) - Upper Cenomanian; Mangyshlak and Russian platform - Cenomanian.

Bohemian Cretaceous: *G. cenomanica* is rich in the sediments of the Upper Cenomanian, mainly in the central part of the Bohemian Cretaceous Basin (Lib-1, Sli-1, Jb-1, DB-1 boreholes).

Gavelinella belorussica (AKIMEC, 1961)
Pl. I, figs. 6, 7

1961 *Anomalina (Brotzenella) belorussica* AKIMEC; AKIMEC, pp. 160, 161, pl. 16, fig. 1a, b, v.
1965 *Anomalina complanata* BERTHELIN; MALAPRIS, pl. 1, fig. 1a, b, c.
1965 *Gavelinopsis infracretacea siniomensis* NEAGU; NEAGU, p. 32, pl. 8, figs. 4-7; pl. 9, figs. 1, 2.
1966 *Gavelinopsis berthelini* (KELLER); MICHAEL, pp. 437, 438, pl. 50, figs. 18, 19.
1972 *Gavelinella (Berthelina) belorussica* (AKIMEC); GAWOR-BIEDOWA, pp. 116-118, pl. 16, fig. 5a-c, text-fig. 10.

Type species is deposited in the collection IGN AN BSSR, No.3/98a, Upper Cenomanian.

Description: test biconvex or moderately planconvex, widely oval, finely perforated. The margin of the test narrow, semetimes even slightly incised in the final part of the whorl. Dorsal side more convex than the ventral one. The surface of chambers, in the initial part of the whorl, is flat, especially the youngest two to three chambers are divided by concave sutures. Other chambers of the test are divided ba flat or slightly thickened sutures which slightly project over the surface of the test. The central part of the test is visibly thickened and has the shape of a strongly convex boss on the dorsal side, occupying almost a quarter of its surface. Ventral side less convex than dorsal, in some speciemens almost flat. The surface of the chamber is flat on the ventral side, except for the last chamber in which it is slightly convex. The chambers are divided by wide, concave sutures, posteriorly deflected. In the central part of the ventral side there is hooklike thickening. Apertural surface triangular, flat or slightly convex. Aperture low, semilinar, surrounded by a narrow lip and reaching under the lamellar flaps of the last chambers. Tests of macrosperical generation are composed of two whorls with a total of 20-23 chambers, with ten chambers in the last whorl; diameter of the proloculus 40 to 60 μm, diameter of the test about 0,354 mm. In the microspherical generation the test is composed of three whorls, 11 to 12 chambers in the last whorl; diameter of the proloculus 20 to 60 μm, diameter of the test about 0,436 mm.

Remarks: over 80 species was found in the sediments of the Bohemian Cretaceous. All of them respond with microspherical generation which has 9 to 10 chambers in the last whorl. This species is variable in size and shape of boss on the dorsal side, convexity of dorsal and ventral side, it can be more or less expressive.

According to AKIMEC, this species entirely coresponds to the species which was included by BERTHELIN (1880) to *A. complanata* REUSS. KELLER (1935) had the same view, when determining new species *Anomalina berthelini* from the Cenomanian and Lower Turonian of the Dnepr-Donec basin. However, he did not introduce its new description but from his short characteristics of this species it is clear that *A. berthelini* and the Berthelin's species from the Albian are very similar but not identical. *G. berthelini* is distinguished by even convex test, wider chambers, flat sutures and generally smaller boss which does not protrude from the surface of the test. In the last whorl there is a smaller number of chambers. GAWOR-BIEDOWA (1972, p. 117, fig. 10) introduces the description and pictures of microspherical and macrospherical generation. However, this description does not conform with reality. The microspheric form is generally noted for small proloculus and large test and the macrospheric form for large proloculus and small test. This characteristics also supports our observation from the Bohemian Cretaceous Basin. However, the allegations by GAWOR-BIEDOWA are quite different.

Distribution: NW and Central Poland (Szczecin, Mogilno, Lodz) - Upper Albian, lesser Cenomanian and Lower Turonian; Germany - Albian, Cenomanian; France, Holland, Romania - Albian; former USSR - upper part of the Upper Cenomanian and Lower Turonian; Dnepr-Donec basin - Cenomanian and Lower Turonian.

Bohemian Cretaceous: uppermost part of the Cenomanian ("plenus marls") DB-1, Lib-1 boreholes, Lower Turonian of boreholes Lib-1, Sli-1, Jb-1, DB-1, Sk-28, VY-1 and Sk-20.

Gavelinella berthelini (KELLER, 1935)
Pl. II, figs. 1-7

1880 *Anomalina complanata* REUSS; BERTHELIN, p. 66, pl. 4, figs. 12, 13.
1935 *Anomalina berthelini* KELLER; KELLER, pp. 552, 553, pl. 2, figs. 25-26.
1954 *Anomalina (Pseudovalvulineria) berthelini* KELLER; VASILENKO, p. 105, pl. 14, figs. 3a, b, v; 4a, b, v.
1939 *Anomalina berthelini* KELLER; MASLAKOVA, pp. 102, 103, pl. 6, fig. 3a, b, v.
1961 *Anomalina (Pseudovalvulineria) berthelini* KELLER; LIPNIK, p. 54, pl. 4, figs. 5a-c; 6a, b.

1961 *Anomalina (Brotzenella) berthelini* KELLER; AKIMEC, pp. 158, 159, pl. 16, fig. 2a, b, v.
1963 *Anomalina (Pseudovalvulineria) berthelini* KELLER; KAPTARENKO-CERNOUSOVA, p. 94, pl. 16, fig. 5a, b, v.
1965 *Gavelinopsis berthelini* KELLER; BACH, p. 25, pl. 6, fig. 3.
1972 *Gavelinella (Berthelina) berthelini* KELLER; GAWOR-BIEDOWA, pp. 118-120, pl. 16, fig. 16, text-fig. 11.
1973 *Anomalina (Brotzenella) berthelini* KELLER; VAPCAROVA, pp. 28-29, pl. 3, figs. 4, 5, 6.

Type species is deposited in the collections IGN AN BSSR No.3/98, Mogylevsk region, upper part of the Turonian.

Description: test rounded, biconvex, smooth or slightly incised in outline; margin rounded. Dorsal side more convex than the ventral one, central part of the test is covered by boss or flat node, not projecting over the surface of chambers. On the ventral side there is narrow umbilicus covered by transparent, flat thickening, which has often hook-like shape, located along the spiral suture. On both sides only last whorl is visible, composed of 8 to 9 triangular chambers, uniformly growing, separated by flat, poorly developed sutures, which are concave between the last chambers. Aperture convex, slitlike with narrow lip, extended onto the ventral side of the test. Wall smooth, finely porous. The representatives of microspheric generation have diameter of proloculus 10,0-17,5 μm and the test is formed of two and half to three whorls with a total of 15-20 chambers. The last whorl has nine chambers. The macrospheric generation has a diameter of proloculus about 30,0-32,5 μm, the test is formed of two to three whorls with 15 to 20 chambers, eight of them in the last whorl.

Remarks: in the Bohemian Cretaceous a great number of well conserved tests was studied, which differ from the original description in a lower number of chambers in the last whorl and slightly larger diameter of the test. This species varies in the degree of convexity in both sides of the test, the number of chambers in the last whorl, the shape of transparent thickening on both sides of the test and the shape and concave sutures between the chambers.

Distribution: NW and Central Poland (Szczecin, Mogilno, Lodz) - Turonian; Anglo-Paris Basin, NW Germany - Upper Albian to Lower Coniacian; Dnepr-Donec basin and Volga district (former USSR) - Cenomanian, Turonian, Caspian Sea region (former USSR) - Turonian; Bulgaria, central part - Cenomanian, Turonian.

Bohemian Cretaceous: Upper Cenomanian ("plenus marls") DB-1, Lib-1 boreholes, Lower Turonian Lib-1, Sli-1, Jb-1, DB-1, Sk-28, KN-3, Sk-20 boreholes, Middle Turonian Sli-1, Jb-1, Sk-28, KN-3, VY-1, Sk-20, Tb-1 boreholes, Upper Turonian Th-1, DC-1, Vf-1, Sli-1, Jb-1, KN-3, KP-1 boreholes, Lower Coniacian Th-11, DC-1, Vf-1, KP-1 boreholes.

Gavelinella baltica BROTZEN, 1942
Pl. III, figs. 1-6

1942 *Gavelinella baltica* BROTZEN; BROTZEN, pp. 50, 51, pl. 1, fig. 7.
1954 *Anomalina (Gavelinella) baltica* (BROTZEN); VASILENKO, p. 75, pl. 7, fig. 2a, b, v.
1957 *Gavelinella baltica* BROTZEN; HOFKER, p. 30, fig. 339a-c.
1959 *Anomalina baltica* (BROTZEN); MASLAKOVA, p. 99, pl. 5, fig. 1a, b, v.
1961 *Anomalina (Gavelinella) cuvillieri* CARBONNIER subsp. *savelievi* VASILENKO; VASILENKO, p. 110, pl. 20, fig. 1a, b, v.
1961 *Anomalina (Gavelinella) baltica* (BROTZEN); AKIMEC, pp. 137, 138, pl. 13, fig. 4a, b, v.
1962 *Gavelinella baltica* BROTZEN; HILTERMANN and KOCH, p. 319, pl. 47, fig. 1.
1962 *Gavelinella baltica* BROTZEN; JEFFERIES, pl. 78, fig. 9a-c.
1972 *Gavelinella (Gavelinella) baltica* BROTZEN; GAWOR-BIEDOWA, pp. 125-126, pl. 17, fig. 5a-c.

Type species is deposited in the collection of the Swedish Geological Survey, Stockholm.

Description: test rounded or slightly oval, biconvex in the rounded margin, sometimes with finely distinguished edge. On the dorsal side two whorls are visible, the concave inner whorl frequently covered with outer whorl, contains nine to twelve chambers, uniformly growing. The septal sutures are wide, flat or slightly convex, sometimes concave between the last chambers. On the dorsal side the spiral suture is visible, on the ventral side only the last whorl with triangular, slightly convex chambers can be seen. Umbilicus narrow, partially covered by triangular lamellae growing from the inner parts of walls adjoining the umbilicus in the last whorl. The septal surface of the last chamber is wide, oval, convex; aperture arcuate, high, extending onto the ventral side towards the umbilicus. Test wall smooth, lustrous, finely porous. In the microspheric individuals, the diameter of the proloculus reaches 22,5 μm, the test is composed of three whorls with a total of 27 chambers, eleven if them in the last whorl. The macrospheric individuals are composed of one and a half to two whorls with a total of 15-17 chambers, 9-10 of them in the last whorl. The diameter of the proloculus amounts to 60,0 to 69,0 μm.

Remarks: about 100 individuals from the Bohemian Cretaceous corresponded with the original description of the species. The size of test, width of umbilicus and convexity of chambers and sutures are variable.

Distribution: NW and Central Poland (Szczecin, Mogilno, Lodz) - Upper Albian to Upper Turonian; NW Germany, Ruhr district - Cenomanian, Turonian (*R. cushmani, W. archaeocretacea* Zones and Lowermost part of *M. coronata* Zone); former USSR - Cenomanian; Bulgaria - Cenomanian to Lower Turonian; Anglo-Paris Basin - Cenomanian (*R. evoluta/P. delrioensis* Zone and *R. cushmani/P. stephani* Zone).

Bohemian Cretaceous: Upper Cenomanian ("plenus marls") DB-1, Lib-1 boreholes, Lower Turonian of boreholes Lib-1, Sli-1, DB-1, Sk-28.

Gavelinella polessica (AKIMEC, 1961)
Pl. VII, figs. 1-9

1961 *Anomalina (Gavelinella) polessica* AKIMEC; AKIMEC, p. 143, figs. 2a, b, v; 3.

Type species is deposited in the collection of IGN AN BSSR, No. 3/86, Upper Cenomanian, Gomel'sk region.

Description: test oval, biconvex, on the dorsal side semi-involute and involute on the ventral side. The spiral is

composed of one and a half to two whorls, extending rapidly with six to eight, mostly seven convex chambers in the last whorl. On the ventral side chambers are triangular, less convex than on dorsal side, sometimes almost flat. The last two chambers are convex. The flat umbilicus is in the central part of the ventral side. On the dorsal side previous whorl is partly visible, chambers rounded, more convex, slightly crooked sutures. The basal aperture rounded to triangular, extending onto the ventral side under the inner termination of the last chamber. Aperture reaches to the umbilicus. Wall of the test thin, finely porous, lustrous. The microsperic generation has two whorls, 7-8 of them in the last whorl. The macrospheric generation has one and a half whorl with 5-6 chambers in the last whorl.

Remarks: a majority of individuals agrees with the original description of species, only individuals found in the Upper Cenomanian from the Bohemian Cretaceous differ by smaller size. On the dorsal side, the shape of the test is variable, as well as the degree of its convexity. Also, the shape of the test varies from rounded forms to oval ones. The shape of sutures is variable and their concavity and convexity are variable too on the ventral side of the test.

This species resembles mainly the species *Gavelinella moniliformis*. Above all, it differs in convex chambers on the ventral side, in their shape and in narrower and flatter umbilicus. The test is thinner, finer and lustrous and is generaly smaller than that of *G. moniliformis*.

Distribution: former USSR, Gomel'sk region, Brests region - Upper Cenomanian;

Bohemian Cretaceous: Upper Cenomanian of the borehole DB-1; Lower Turonian of the boreholes Lib-1, Jb-1, DB-1, Sk-28, KN-3, VY-1, Sk-20; Middle Turonian Th-11, DC-1, Sli-1, DB-1, Sk-28, KN-3, VY-1, Sk-20 boreholes; Upper Turonian Th-11, DC-1, Sli-1, Jb-1, DB-1, KN-3, VY-1, Sk-20 boreholes; Lower Coniacian of the boreholes Th-11, DB-1.

Gavelinella moniliformis (REUSS, 1845)

Pl. VIII, figs. 1-9; Pl. IX, figs. 1-2

1845 *Rosalina moniliformis* REUSS; REUSS, p. 36, pl. 12, fig. 30; pl. 13, fig. 67.
1899 *Anomalina moniliformis* (REUSS); EGGER, p. 230, pl. 27.
1925 *Anomalina moniliformis* (REUSS); FRANKE, p. 96, pl. 8.
1928 *Anomalina moniliformis* (REUSS); FRANKE, p. 181, pl. 16, fig. 10a, b, c.
1942 *Gavelinella moniliformis* (REUSS); BROTZEN, pp. 49-50, fig. 17.
1954 *Anomalina* (*Gavelinella*) *moniliformis* REUSS; VASILENKO, p. 83, pl. 8, fig. 6a, b, v.
1961 *Anomalina* (*Gavelinella*) *moniliformis* REUSS; AKIMEC, p. 142, pl. 14, fig. 1a, b, v.
1963 *Anomalina* (*Gavelinella*) *moniliformis* REUSS; KAPTARENKO-CERNOUSOVA, pp. 3-200.
1975 *Gavelinella* (*moniliformis*) *moniliformis* REUSS; TEISSEYRE, 117, pl. 1, fig. 3a-c.
1980 *Gavelinella moniliformis* REUSS; GAWOR-BIEDOWA, p.43.

Type species: place of deposition not given.

Description: test oval or rounded, the periphery rounded. The dorsal side slightly evolute, with two visible whorls. The last whorl composed of six to eight chambers. The sutures between the chambers concave, narow, slightly crooked. On the ventral side chambers triangular, convex, the last chamber strongly convex. Umbilicus wide, deep. The septal surface of the last chamber wider than high, convex, on the ventral side oblique. Aperture has the shape of narrow slit with the border and it is extending onto the ventral side under the inner termination of the chamber. The test porous, coarser. The macrospheric form has two whorls with a total of 13 chambers, six to seven of them in the last whorl. The diameter of proloculus 0,028 mm. The microspheric generation has 18 chambers, three whorls and 7-8 chambers in the last whorl. The difference between both generations in the number of chambers in the last whorl is not expressive, the total number of the chambers of the test is conclusive.

Remarks: a great number of well preserved individuals from the Bohemian Cretaceous correspond to the original description of the species. The dimension of the test, convexity of chambers in the last whorl and size and deviation of the last chamber and width of the umbilicus are variable.

Distribution: Bulgaria - Turonian, Coniacian, Santonian; former USSR, Caspian region, Mangyslak peninsula - Turonian;

NW and Central Poland - Upper Turonian to Coniacian.

Bohemian Cretaceous: Lower Turonian Sk-28, Lib-1 boreholes, Middle Turonian Vf-1, Lib-1, Sli-1, Jb-1, DB-1, Sk-20, Tb-1 boreholes, Upper Turonian Th-11, Sli-1, Jb-1, Db-1, Sk-20, Kp-1 boreholes, Lower Coniacian Th-11, Sli-1, Jb-1, DB-1, KN-3, Sk-20, KP-1 boreholes, Upper Coniacian Vf-1, KP-1 boreholes.

Gavelinella ukrainica (VASILENKO, 1954)

Pl. VII, figs. 10-12

1954 *Anomalina* (*Gavelinella*) *moniliformis* (REUSS) subsp. *ukrainica* VASILENKO; VASILENKO, p. 82, pl. 8, fig. 5a, b, v.

Type species is deposited in the collection VNIGRI No. 4727, Turonian of Donbas.

Description: test oval, margin moderately rounded. The dorsal side partially evolute with two whorls visible. Seven to nine oblique chambers in the last whorl, separated by moderately concave sutures on the dorsal side. Sutures on the ventral side are obscure and the test is almost flat. The last chamber increased in size, moderately extending on the ventral side. Aperture slitlike, extending towards the narrow umbilicus. The surface of the dorsal side smooth, on the ventral side coarsely porous.

Remarks: in the Bohemian Cretaceous Basin more than 70 individuals were studied. The dimension of the test and the convexity of the last chamber and its deviation of the ventral side are variable in this species. VASILENKO (1954) described this species as subspecies *Gavelinella moniliformis ukrainica*. Because this species differs from *G. moniliformis* at principal features, which are not liable to the variability, as for example the shape of chambers (at *G. ukrainica* oblique, narrower, at *G. moniliformis* oval, paunchy.) I include, however, the VASILENKO's subspecies

within the independent species *Gavelinella ukrainica* (VASILENKO). Also the stratigraphic range of this species is restricted only to the Middle Turonian and Lower Coniacian, whereas *G. moniliformis* has a wider stratigraphical range.

Distribution: former USSR.

Bohemian Cretaceous: Middle Turonian of Th-11, DC-1, Vf-1, Jb-1, DB-1, Sk-28, Sk-20 boreholes, Upper Turonian of DC-1, Vf-1, Sli-1, Jb-1, DB-1, KN-3, Sk-20 boreholes; Lower Coniacian of Th-11, Vf-1, KN-3, VY-1, KP-1 boreholes.

Gavelinella schloenbachi (REUSS, 1863)
Pl. V, figs. 1-6

1863 *Rotalia schloenbachi* Reuss; Reuss, p. 87, pl. 10, fig. 5a-c.
1935 *Planulina schloenbachi* (REUSS); KELLER, p. 553, pl. 3, figs. 22-24.
1947 *Planulina schloenbachi* (REUSS) var. *kelleri* MJATLJUK; MJATLJUK in VASILENKO et MJATLJUK, p. 212, pl. 3, fig. 10a-c.
1954 *Anomalina (Pseudovalvulineria) kelleri* MJATLJUK; VASILENKO, p. 98, pl. 13, fig. 1a, b, v.
1959 *Anomalina kelleri* MJATLJUK; MASLAKOVA, p. 101, pl. 6, fig. 1a-v.
1961 *Anomalina (Pseudovalvulineria) kelleri* MJATLJUK var. *dorsoconvexa* AKIMEC; AKIMEC, pp. 150-152.
1965 *Planulina schloenbachi* (REUSS); NEAGU, p. 32, pl. 8, fig. 3a-c.
1972 *Anomalina (Pseudovalvulineria) schloenbachi* (REUSS); GAWOR-BIEDOWA, p. 129, pl. 16, fig. 2a-c.
1981 *Gavelinella schloenbachi* (REUSS); EDWARDS, p. 402, pl. 56, figs. 10-12.

Type species: place of deposition not given.

Description: test rounded or slightly oval, flat, thin. The outline smooth or slightly lobal with the narrow border and intimate keel. The dorsal side mostly slightly convex, the ventral side flat or slightly concave. Dorsal side bears all whorls visible. The inner whorl very narrow, sometimes distinctly separated at the chambers. The last whorl composed of 9-11 chambers on the dorsal side. The chambers of the initial part of the whorl are triangular with the flat surface, in the final part of whorl they are trapezoidal, wider, with convex surface, separated by narrow, arched, filletted sutures, sometimes thickened. On the ventral side only the last whorl is visible, composed of triangular chambers, whereas the last chambers in the final part of the whorl are slightly convex, separated by deeper subradial sutures. The proximal terminations of the chambers sometimes extend to projections which partially cover the umbilicus. Aperture bow-shape arched, located in the margin of the test, extends on the ventral side below the termination of the last chambers.

The microspheric individuals are very flat, rounded or slightly oval, with all whorls visible. Their test is composed of three whorls with a total of 23 chambers and 8-11 of them in the last whorl. The proloculus is not generally visible. The macrospheric individuals are suboval, with the convex dorsal, and concave ventral side. On the dorsal side, the proloculus is clearly visible. Test is composed of two whorls with 16 chambers, 9 of them in the last whorl. The diameter of the proloculus is 40 μm.

Remarks: great number of the individuals found in sediments of the Bohemian Cretaceous Basin respond to the original description of the species. Individuals of this species have not only variable shape and size of the tests, but also the width of umbilicus,the outline of the test and the convexity of the last chambers.

G. schloenbachi was formerly described under different names of species and subspecies probably owing to high variability of its test, which is adaptable to conditions of the life environment. This species has wide stratigraphic range from the Upper Albian of north Germany to the Campanian, where EDWARDS (1981) mentioned great number of individuals from the Anglo-Paris Basin (*Belemnitella mucronata* Zone).

VASILENKO and MJATLJUK (1947) differentiated *Rotalia schloenbachi* REUSS and *Planulina schloenbachi* (REUSS) var. *kelleri* on the basis of the presence of a small discus in the centre of the dorsal side. In addition, these authors separated *A. schloenbachi* var. *kelleri* from *A. schloenbachi* var. *kalinina* on the basis of the absence of the discus (and more visible arterisk in the later forms). During the contemporary research it was stated that the central discus or knob is subjected to the variability and therefore it is not possible to determine the subspecies only on the basis of this difference. Also, MJATLJUK's subspecies *Anomalina (Pseudovalvulineria) kelleri* var. *kelleri* and *A. (P.) kelleri* var. *dorsoconvexa* conform with the original description of the species, especially with *A. (P.) kelleri* var. *dorsoconvexa*. Some individuals of subspecies *A. (P.) kelleri* var. *kelleri* can be probably added to *Gavelinella stelligera* (MARIE). The subspecies of MJATLJUK differ from *G. stelligera* only in the vitric discus on the dorsal side and small, inexpressive, star-shaped ornamentation on the ventral side, and in smaller size.

Distribution: NW Germany - Upper Albian up to the lowermost Cenomanian; NW and Central Poland (Szczecin, Mogilno, Lodz) - Upper Albian to Lower Turonian; former USSR, Caspian region, Dnepr-Donec Basin, Mangyslak peninsula and Volga district - Turonian, the solitary specimens from the Coniacian Volyn-Podolsk Lowlands; Anglo-Paris Basin - Turonian, Coniacian, Santonian, the larger bloom at Campanian - *Belemnitella mucronata* Zone.

Bohemian Cretaceous: Lower Turonian of boreholes Lib-1, Jb-1, DB-1, Sk-, KN-3; Middle Turonian of the boreholes Th-11, DC-1, Lib-1, Sli-1, Jb-1, DB-1, Sk-, VY-1, Sk-20; Upper Turonian of the boreholes Th-11, DC-1, Sli-1, Jb-1, DB-1, KN-3, VY-1, Sk-20; Lower Coniacian of the boreholes Th-11, Vf-1, KN-3, VY-1, KP-1; Upper Coniacian of the borehole KP-1.

Gavelinella ammonoides (REUSS, 1845)
Pl. III, figs. 7-9

1845 *Rosalina ammonoides* REUSS; REUSS, p. 36, pl. 4, fig. 2a-c.
1850 *Rosalina ammonoides* REUSS; REUSS, pp. 17-52, pls. 2-6.
1925 *Anomalina ammonoides* REUSS; FRANKE, p. 96, pl. 8.
1939 *Anomalina ammonoides* REUSS; MOROZOVA, p. 81, pl. 1, figs. 23-26.
1942 *Gavelinella ammonoides* REUSS; BROTZEN, pp. 48, 49, text-fig. 16.
1947 *Anomalina ammonoides* REUSS; VASILENKO and MJATLJUK, p. 207, pl. 3, fig. 1a-c.

1954 *Anomalina* (*Gavelinella*) *ammonoides* REUSS; VASILENKO, p. 77, pl. 7, fig. 3a-c.
1959 *Anomalina ammonoides* REUSS; MASLAKOVA, p. 99, pl. 6, fig. 6a-c.
1961 *Anomalina* (*Gavelinella*) *ammonoides* (REUSS); AKIMEC, p. 138, pl. 13, fig. 5a, b, v.
1963 *Anomalina* (*Gavelinella*) *ammonoides* (REUSS); KAPTARENKO-CERNOUSOVA, p. 92, pl. 17, fig. 1a-v.
1973 *Anomalina* (*Gavelinella*) *ammonoides* (REUSS); GAWOR-BIEDOWA, pp. 3-54, pl.1-10.

Type species: place of deposition not given.

Description: test more or less rounded, flat, more convex on the ventral side, composed of two and half to three whorls. The central part of the dorsal side is imperceptibly concave with all the whorls visible. 7-9 chambers in the last whorl. The crooked sutures stand out. The outer rim of the test rounded, slightly convex, wall dim, thinly porous. Aperture extends to the ventral side towards the umbilicus, which is sometimes partially covered by small projections of proximal part of chambers. GAWOR-BIEDOWA (1972) introduced the individuals of two generations. The differences of the generation are not so remarkable judging from the outer morphology. However, thin sections show, that the microspheric test is composed of two and half whorls with 16 chambers, 7-9 of them in the last whor. The diameter of proloculus is 19 µm. The test of microspheric generation is composed of two whorls with 12-13 chambers, 8 of them in the last whorl. The diameter of proloculus between 26-29 µm.

Remarks: from the sediments of the Bohemian Cretaceous Basin more than 80 individuals were studied corresponding to original description of the species, only the protrusions of the chambers towards the umbilicus are inexpressive or absent. The convexity of the last chamber, the width and depth of the umbilicus, the length of projections of the chambers in the umbilicus and the height of the septal sutures can be possibly included into the inner variability of species. *Gavelinella ammonoides* is closely affined to *Gavelinella baltica*, which is evolutionary older, and to evolutionary younger *Gavelinella lorneiana*. The morphological changes during the evolution consist in the width of umbilicus, the shape and dimension of chambers and distance between sutures of the chambers.

Distribution: former USSR - Turonian to Coniacian; Poland - Upper Turonian to Coniacian; NW Germany - Turonian, Coniacian.

Bohemian Cretaceous: Middle Turonian of the boreholes Jb-1, KN-3; Upper Turonian of DC-1, Tb-1 boreholes; Lower Coniacian of Th-11, Vf-1, VY-1 boreholes.

Gavelinella lorneiana (D'ORBIGNY, 1840)
Pl. IV, figs. 1-6

1840 *Rosalina lorneiana* D'ORBIGNY; D'ORBIGNY, p. 36, pl. 3, figs. 20-22.
1845 *Discorbina lorneiana* (D'ORBIGNY); REUSS, p. 456.
1880 *Anomalina rudis* (REUSS); BERTHELIN, p. 68, pl. 4, fig. 15.
1909 *Anomalina* (*Rosalina*) *lorneiana* (D'ORBIGNY); EGGER, p. 45, pl. 4, figs. 10-12.
1931 *Anomalina clementiana* (D'ORBIGNY); CUSHMAN, p. 46, pl. 6, fig. 10a-c.
1936 *Anomalina lorneiana* (D'ORBIGNY); BROTZEN, pp. 178-181,pl.12, fig. 1a-c, text-fig. 64.
1941 *Discorbina lorneiana* (D'ORBIGNY); MARIE, pp. 214-216, pl. 33, fig. 314a-c; pl. 34, fig. 315a-c.
1941 *Discorbis lorneiana* (D'ORBIGNY) var. *costulata* MARIE; MARIE, p. 216, pl. 34, fig. 315a-c.
1946 *Anomalina clementiana* (D'ORBIGNY); CUSHMAN, p. 155, pl. 63, figs. 12, 13.
1954 *Anomalina clementiana* (D'ORBIGNY); FRIZZELL, p. 130, pl. 21, fig. 2a-c.

Type species: place of deposition not given.

Description: test convex, trochospirally coiled with a subcircular periphery. On the dorsal side, the last whorl is visible, in the central part of the test, the chambers of the inner whorls are partially visible. These whorls can be sometimes covered with thin boss. The ventral side is more convex, with the last whorl composed of 8-10 convex chambers. The last chamber is strongly convex. The septal sutures equal or slightly crooked, on the ventral side mostly covered with ridges. Ridges are separated by coarsely perforated areas. The umbilicus narrow, deep, partially covered by projections of proximal part of chambers. The apertural surface wide, flat or slightly arched. Aperture slitlike with narrow lip, extending into the umbilicus. The microspheric generation has 9-10 chambers in the last whorl with the diameter of the proloculus 15-22 µm. The macrospheric generation has has the test composed of two whorls; 8 chambers in the last whorl. The diameter of the proloculus 30-50 µm.

Remarks: more than 60 individuals from the sediments of the Bohemian Cretaceous correspond with the original description of the species. The convexity of the last chambers, the size and the shape of the test, together with the size of proximal projections of the chambers in the umbilicus, are variable. According to BROTZEN (1936) the individuals described from Eriksdal correspond with the description and illustration of type specimens. Only one form described by D'ORBIGNY has a higher number of the chambers in the last whorl, which can be explained by the variability of the species. Similarly, *Discorbis lorneiana costulata* Marie differs from *Discorbis lorneiana* by the number of the chambers in the last whorl, by more convex apertural region and by the presence of the vitric discus in the middle part of the dorsal side. All of these marks can be involved into the variability of the species ; therefore both the forms are ranged to the synonyma of the species.

Distribution: NW Germany - Lower Turonian; Anglo-Paris Basin from the *Holaster planus* Zone (the uppermost part of the Turonian) to the top of the *Belemnitella minor* Subzone (*B. mucronata* Zone) - Upper Campanian.

Bohemian Cretaceous: Upper Coniacian of the borehole KP-1.

Gavelinella praeinfrasantonica (MJATLJUK, 1947)
Pl. V, figs. 7, 8.

1947 *Anomalina praeinfrasantonica* MJATLJUK; VASILENKO and MJATLJUK, p. 211, pl. 3, fig. 8a-c.
1954 *Anomalina* (*Pseudovalvulineria*) *praeinfrasantonica* MJATLJUK; VASILENKO, p. 101, pl. 13, fig. 5a-c.
1961 *Anomalina* (*Pseudovalvulineria*) *praeinfrasantonica* MJATLJUK; VASILENKO, p. 124, pl.22, fig. 1a-c.

Type species is deposited in the collection IGN AN URSR under the No. P-663a and derives from the Upper Coniacian of the Konks-Jalinsk basin.
Description: test biconvex, dorsal side semievolute with the inner whorls partly visible, which are sometimes covered by slightly indicated vitric discus. In the last whorl there are 10-11 chambers separated by double sutures, slightly standing-out. The ventral side the last whorl is visible, composed of relatively narrow chambers separated by crooked, double, slightly standing-out sutures. Around the narrow umbilicus the star-shaped thickness is slightly indicated. This feature can be imperceptible or totally absent at some individuals.

Remarks: 45 individuals from the Bohemian Cretaceous correspond to the original description of the species. *G. praeinfrasantonica* varies, above all, by the surface of both sides, the size of vitric discus and star-shaped thicknesses. This species is similar to *G. vombensis* in the principal morphology, but differs mainly in the chambers. *G. praeinfrasantonica* constitutes transient link between *G. schloenbachi* and *G. vombensis*.

Distribution: former USSR, Mangyslak, Caspian Sea region - Turonian to Coniacian; Anglo-Paris Basin - Turonian to Coniacian; at the base of the *Micraster coranguinum* Zone it disappears.

Bohemian Cretaceous: Upper Turonian Sli-1, Jb-1, KN-3 boreholes; Lower Coniacian: Th-11, KN-3, VY-1 boreholes.

Gavelinella vombensis (BROTZEN, 1945)
Pl. VI, figs. 1-6

1945 *Pseudovalvulineria vombensis* BROTZEN; BROTZEN, p. 50, pl. 1, figs. 12a-c, 13a-c; p. 51, pl. 9, figs. 1a-c, 2a-c, 3a-c, 4a-c.
1947 *Anomalina infrasantonica* MJATLJUK; VASILENKO and MJATLJUK, pp. 210-211, pl. 3, figs. 2a-c, 3a-c.
1954 *Anomalina* (*Pseudovalvulineria*) *infrasantonica* MJATLJUK; BALACHMATOVA in VASILENKO, p. 102, pl. 13, fig. 6a-c.
1961 *Anomalina* (*Pseudovalvulineria*) *infrasantonica* MJATLJUK; AKIMEC, p. 154, pl. 15, fig. 5a, b, v.
1980 *Gavelinella vombensis* BROTZEN; GAWOR-BIEDOWA, p. 44.
Type species is deposited in the collection of the Swedish Geological Survey, Stockholm.
Description: test rounded to oval, biconvex, more convex on the ventral side than on the dorsal one. The dorsal side semievolute with 2-3 whorls. The last whorl composed of 10-12 chambers, partially covers the chambers of the inner whorls which are covered also by slightly exposed vitric discus. The chambers separated by double septal sutures at the older whorls are inexpressive. The ventral side convex, involute. Triangular chambers of the last whorl separated by wide, double, convex sutures. In the middle part of the ventral side there are stellate serpent-like and thread-like depressions partially covering the umbilicus. The outer side obliquely rounded, flat or slightly lobate. The apertural surface triangular, convex. Aperture basal, narrow, arched, bordered by narrow lip, extending into the umbilicus.

GAWOR-BIEDOWA (1980) described in her materials (7 individuals) only one generation of species, constituted of three whorls, the last one of 13 chambers and the size of proloculus 22 μm. The macrospheric generation has the test composed of two to two and half whorls with a total of 21 to 22 chambers. In the last whorl there are 10 chambers and the size of proloculus is 45 μm.

Remarks: more than 100 very well preserved individuals from the Coniacian of the Bohemian Cretaceous corresponding with the original description of the species was found. Into the variability of the species we can involve, above all, the presence or absence of the vitric discus on the dorsal side, the length and width of septal sutures on the ventral side and the areal extent of depressions around the umbilicus.

Soviet and Bulgarian paleontologists introduced the individuals of this species as Anomalina infrasantonica Mjatljuk. The present authors involve this species into the synonym *G. vombensis*, because it quite corresponds to the original description of this species.

Distribution: former USSR - Volga region, Mangyslak, Dnepr-Donec basin, Donbas, Voronezh platform - Lower Santonian, isolately also in the Coniacian; Poland, Germany - Turonian, Coniacian.

Bohemian Cretaceous: Lower Coniacian: Th-11, VY-1, KP-1 boreholes, Upper Coniacian: KP-1 borehole.

Gavelinella stelligera (MARIE, 1941)
Pl. VI, figs. 7-9

1941 *Planulina stelligera* MARIE; MARIE, p. 245, pl. 37, fig. 344a-c.
1963 *Anomalina* (*Pseudovalvulineria*) *stelligera* (MARIE); KAPTARENKO-CERNOUSOVA et al., pl. 20, fig. 5a-c.
1981 *Gavelinella stelligera* (MARIE); EDWARDS, p. 404, pl. 58, figs. 12-14.
Type species is deposited in the personal collection of the author, No. 6247 comes from the Paris Basin, Em-2 Zone, Campanian (*Belemnitella mucronata* Zone).
Description: test narrowly depressed, planispiral, unsymmetrical with flat or slightly convex sides. In the last whorl 12-13 narrow, crooked chambers. The dorsal side mostly evolute. On the middle part of the ventral side of the test the stellate-shaped form is visibled. This feature is formed by projections of proximal parts of chambers covering the umbilicus. The septal sutures on the surface of both side of the test are either flat or slightly depressed. Aperture extending towards the ventral side under projections of chambers. The wall of the test very finely perforated.

The individuals found in the Lower Santonian of the Bohemian Cretaceous Basin belong to one natility generation. The test composed of two whorls with a total of 18-19 chambers. In the last whorl 12 chambers. The size of proloculus 20 μm.

Remarks: the individuals from the Lower Santonian of the Bohemian Cretaceous correspond with the original description of the species. The size and shape of the stellate-shaped forms around the umbilicus are variable.

Distribution: Ukraine, Russian platform, Krym and northern part of the Kavkaz region - Santonian; Anglo-Paris Basin - top of the *Micraster coranguinum* Zone

(Lower Santonian) to base of the Subzone *Belemnitella minor* (*B. mucronata* Zone) - Upper Campanian.

Bohemian Cretaceous: Lower Santonian: Vf-1 borehole.

Gavelinella pertusa (MARSSON, 1878)
Pl. IV, figs. 7-9

1878 *Discorbina pertusa* MARSSON; MARSSON, p. 166, pl. 4, fig. 35a-c.
1925 *Anomalina pertusa* (MARSSON); FRANKE, p. 86, pl. 7, fig. 16.
1928 *Anomalina pertusa* (MARSSON); FRANKE, p. 182, pl. 17, fig. 15a, b.
1932 *Anomalina pertusa* (MARSSON); CUSHMAN, p. 345, pl. 51, fig. 15a, b.
1941 *Discorbis lorneiana* (D'ORBIGNY) *pertusa* (MARSSON); MARIE, p. 217, pl. 34, fig. 316a-c.
1942 *Gavelinella costata* BROTZEN; BROTZEN, p. 43-45, pl. 1, fig. 3.
Type species comes from Sassnitz at Ruiana, Campanian/Maastrichtian Riksmusset and from Höllwiken, depth 72-73 m, Maastrichtian.

Description: test small, rather flat, trochoidal. The margin slightly rounded. The dorsal side flat, the middle part concave and partially filled with the vitric matter of the flat discus. The chambers of the dorsal side flat or slightly rounded, separated by more expressive flat septal ridges. In the last whorl 10-12 chambers. The ventral side has only the last whorl visible, composed of chambers more convex than on the dorsal side, separated by wide and flat septal ridges. Umbilicus narrow, rounde, smooth. Aperture arched, extending on the ventral side towards the umbilicus.

Remarks: MARSSON (1878, p. 166) mentioned in his original description of *Discorbina pertusa* that the chambers are separated by weak sutures and did not mention the number of chambers in the last whorl. MARSSON illustrated on the pl. 35b thirteen chambers, whereas on the pl. 35a and 35d only twelve chambers can be seen. All species described later as *Gavelinella pertusa* have ten to eleven chambers in the last whorl and well visible septal ridges. Into the synonym of the species has been included also *Gavelinella costata*, which Brotzen separated from *G. pertusa* only on the basis of the size and flattness of the septal ridges, which are the marks included within the variability of the species.

Distribution: Anglo-Paris Basin - base of the *Micraster coranguinum* Zone (Upper Coniacian) to the top of the *Belemnitella mucronata* Zone (top of the Campanian).

Bohemian Cretaceous: Lower Coniacian (Th-11 borehole) to Lower Santonian (Vf-1 borehole).

Gavelinella tumida BROTZEN, 1942
Pl. IX, figs. 3-6

1942 *Gavelinella tumida* BROTZEN; BROTZEN, p. 47, fig. 15.
Type species is deposited in the collection of the Swedish Geological Survey from Höllwiken, depth 900-1000 m (Santonian).

Description: test biconvex, margin rounded. Sutures between chambers slightly inside-out. In the last whorl eight to nine convex chambers distinctly separated by septal ridges. The central part of the dorsal side slightly concave, the inner whorls covered by vitric, flat, rounded discus. In some individuals, the inner whorls are shown through. On the ventral side the deep umbilicus partially covered by projections of proximal parts of chambers is visible. Wall of the test coarse, strongly porous. In the material from the Bohemian Cretaceous the individuals with only nine chambers in the last whorl were found as well.

Remarks: *Gavelinella tumida* is similar to *G. lorneiana*, differs always by the distinctly visible large umbilicus and strongly convex chambers. *G. tumida* has close affinity to *G. moniliformis* because both species are members of one evolutionary line. As to exterior morphology, the two species can be distinguished by width of umbilicus, which is covered by projections in proximal parts of chambers at G. *tumida*. This species has generally larger tests and greater number of the chambers in the last whorl. The species differ by structure of the chambers. The chambers of G. *tumida* are generally higher than the chambers of G. *moniliformis*.

Distribution: Sweden - lower part of the Santonian; Poland, Zamoscia region; NW Germany - Santonian.

Bohemian Cretaceous: Upper Coniacian (Th-11 borehole) and the Lower Santonian (Vf-1 borehole).

Genus *Lingulogavelinella* MALAPRIS, 1969
Type species: *Lingulogavelinella albiensis albiensis* MALAPRIS, 1969

Lingulogavelinella albiensis MALAPRIS *arachnoidea* GAWOR-BIEDOWA, 1972
Pl. XII, figs. 4-7

1965 *Lingulogavelinella albiensis* MALAPRIS; MALAPRIS, p. 140, pl. 4, figs. 5-8.
1972 *Lingulogavelinella asterigerinoides asterigerinoides* (Plummer); GAWOR-BIEDOWA, p. 101, pl. 14, fig. 5a-c.
1972 *Lingulogavelinella asterigerinoides* (PLUMMER) *arachnoides* GAWOR-BIEDOWA; GAWOR-BIEDOWA, p. 104, pl. 15, figs. 1a-c; 2a-c.
Type species comes from the Upper Albian sediments of borehole Lodz 5a SW of Warszawa, 608.5 m.

Description: test involute, biconvex, rounded, the outline even, the outer rim of the test rounded. Dorsal side less involute than the ventral side with the discus visible in the middle part of the test. Sutures sigmoidal, slightly transparent, mostly visible near the middle part of the test only. The surface of the chamber convex in the last whorl. The chambers of the last whorl flat or slightly convex on the ventral side. The septal sutures sigmoidal, concave. The vitric knob in the middle part of the ventral side of the test is surrounded by forms resembling in the shape and pattern the arrangement of spider limbs. Apertural surface convex, aperture arcuate with wide lip, extending onto the ventral side.

Remarks: According to GAWOR-BIEDOWA (1972), *L. albiensis* MALAPRIS 1965 and *L. albiensis albiensis* MALAPRIS-BIZOUARD, 1967 are synonyma of *L. asterigerinoides asterigerinoides* (PLUMMER, 1931). Later (1982), she accepted the name *L. albiensis arachnoides* and also confirmed validity of *L. albiensis arachnoides* GAWOR-BIEDOWA, 1972. I supposed this elision and agree with her opinion. Both these subspecies - *L. albiensis albiensis* and *L. albiensis arachnoides* - differ by the number of chambers, by thickness of the test and by the shape of the or-

namentation on the ventral side as well as by the presence of the vitric boss on both sides.

Distribution: Poland, Lodz - Upper Albian, Cenomanian;

Bohemian Cretaceous: Upper Cenomanian DB-1 borehole.

Lingulogavelinella globosa (BROTZEN, 1945)
Pl. X, figs. 1-9

1945 *Anomalina globosa* BROTZEN; BROTZEN, pp. 55, 56, pl. 2, fig. 6a-c.
1954 *Anomalinoides globosa* BROTZEN; POZARYSKA, p. 268, fig. 28a-c.
1958 *Anomalinoides globosa* BROTZEN; WITWICKA, p. 228, pl. 19, fig. 38a-c.
1961 *Anomalina* (*Pseudovalvulineria*) *globosa* (BROTZEN); VASILENKO, pp. 113, 114, pl. 20, figs. 2a,b,v; 5a, b, v.
1961 *Cibicides* (*Anomalinoides*) *globosa* (BROTZEN); LIPNIK, pp. 57, 58, pl. 6, fig. 1a-c.
1961 *Anomalina* (*Pseudovalvulineria*) *globosa* (BROTZEN); AKIMEC, p. 156, pl. 15, figs. 7a, b, v; 8a, b, v.
1962 *Anomalinoides globosa* BROTZEN; JEFFERIES, p. 78, fig. 19a-c.
1963 *Cibicides* (*Anomalinoides*) *globosus* (BROTZEN); KAPTARENKO-CERNOUSOVA et al., p. 202, pl. 3, fig. 6a-c; pl. 4, fig. 4a-c.

Type species comes from Höllviken, Scania, Sweden from Cenomanian sediments. The original is illustrated in BROTZEN (1945), pl. 2, fig. 6a-c.

Description: test rounded, slightly convex, outside rounded with the concave sutures on the periphery. Involute or semiinvolute dorsal side has mild depression in the middle part and the last whorl convex. The sutures between the chambers narrow, concave. Chambers are triangular to rounded in shape. Ventral side without umbilicus. On the ventral side the septal sutures are extended towards the middle part of the test, forming together the projections of the proximal parts of the chambers, the stallar pattern. The apertural surface of the last chamber round to oval, convex. Aperture low with the border, exceeding on the ventral side of the test. The wall of the test thin, finely porous.

Remarks: from the Upper Cenomanian and Lower Turonian of the Bohemian Cretaceous Basin about 90 well preserved individuals which correspond with the original description of the species were studied. This species is variable, mainly as regards the shape of the test and the character of the dorsal side which is semiinvolute to involute. This species was described first by Brotzen from the Cenomanian of Sweden and it was classified with the genus *Anomalinoides*. VASILENKO (1961) and AKIMEC (1961) placed this species to subspecies *Pseudovalvulineria*, BUTT (1966) described a new genus *Orostella* with the typical species *Orostella turonica* from the Paris Basin. However, this species is identical with *A. globosa*. Consequently, the genus *Orostella* is a younger synonym of the genus *Lingulogavelinella*. *L. globosa* is a significant foraminifer marked by the projections on the ventral side of the test forming the stellar pattern. *L. globosa* is a representant of Upper Cenomanian forms and their bloom ranged in the Lower Turonian in the Bohemian Cretaceous Basin.

Distribution: Sweden, Höllwiken - Cenomanian, central part of Poland - Middle Cenomanian to Middle Turonian, Rhone region - Lower Turonian, Volga-Podol basin - Cenomanian, Anglo-Paris Basin - Upper Cenomanian, Zone 13, the largest occurence Zone 14/i/ii "plenus marls"; France (cher Valley, Toursin) - the Cenomanian/Turonian boundary.

Bohemian Cretaceous: Upper Cenomanian DB-1, Lib-1 boreholes; Lower Turonian Lib-1, Jb-1, Db-1, Sk-28, KN-3, Vy-1, Sk-20 boreholes.

Lingulogavelinella jarzevae (VASILENKO, 1954)
Pl. XI, figs. 1-3

1945 *Cibicides formosa* BROTZEN; BROTZEN, p. 55, pl. 2, fig. 2a-c.
1954 *Cibicides* (*Cibicides*) *jarzevae* VASILENKO; VASILENKO, p. 121, pl. 17, fig. 3a-v.
1961 *Cibicides* (*Cibicides*) *jarzevae* VASILENKO; AKIMEC, p. 163, pl. 16, fig. 4a, b, v.
1961 *Anomalina* (*Pseudovalvulineria*) *jarzevae* (VASILENKO); VASILENKO, p. 114, 115, pl. 20, figs. 3a, b; 4; p. 319, pl. 46, fig. 1a-c.
1972 *Lingulogavelinella formosa* (BROTZEN); GAWOR-BIEDOWA, pp. 105, 106, pl. 14, fig. 1a-c, text-fig. 7.
1972 *Anomalina* (*Pseudovalvulineria*) *jarzevae* VASILENKO; VAPCAROVA, p. 97, pl. 4, figs. 22, 23, 34.

Type species is deposited in the collection of the Swedish Geological Survey, Stockholm.

Description: test small, involute, the ventral side flat, the dorsal side strongly convex. On both sides only the last whorl, of six to eight chambers, is visible. Chambers on the ventral side are flat, crooked, separated by indistinct, narrow, flat sutures. The inner terminations of the chambers are concluded by projections which form the stellar-like pattern. On the dorsal side, the chambers are high, strongly convex, with rounded-off apexes. The chambers are gradually increasing and separated by radial, narrow sutures in the proximal part, strongly concave or flat near the margins. The outer rim of the test narrow, rounded, the umbilicus narrow and deep. Aperture low, semilunar, surrounded by narrow border and extended to the dorsal side in the shape of narrow slit. The wall of the test smooth, finely porous.

Remarks: from the Lower Turonian of the Bohemian Cretaceous Basin ten individuals corresponding with the original description of the species were studied. the individual variability is manifested by convexity of the test on the dorsal side and the size of the test, the degree of the bend and the expressivity of the sutures on both sides of the test as well as by the size and shape of the starlike pattern on the ventral side. BROTZEN's specimen, described as *Cibicides formosa* BROTZEN, was given a new specific name *Cibicides* (*Cibicides*) *jarzevae* VASILENKO (1954). He (BROTZEN) found that the specific name *C. formosa* has been employed by Sequenza in 1880 to call the species of the genus *Cibicides* coming from the Pliocene deposits of Italy. Later, this species was classified within the genus *Lingulogavelinella* MALAPRIS on the basis of the shape of the test and the projections of the periumbilical parts of chambers forming a star-shaped ornamentation. According to HILTERMANN and KOCH (1962), *Cibicides formosa* BROTZEN begins to develop in the Upper Cenomanian deposits, when the chambers became stronghly convex on the dorsal side owing to an attached manner of life.

Distribution: Sweden, Höllwiken, Scanian; Anglo-

Paris Basin - Upper Albian, zones 5a-6, 6a and from the Lower cenomanian zones 7-9. In the Lower Cretaceous of NW England the first occurrence was reported from the base and from a thin layer of the uppermost part of the Zone 10 and from the boundary of the Zone 10/11i;

Bohemian Cretaceous: Lower Turonian of the boreholes Lib-1, Jb-1.

Lingulogavelinella pazdroae GAWOR-BIEDOWA, 1972
Pl. XI, figs. 4-6; Pl. XII, fig. 1-3

1972 *Lingulogavelinella pazdroae* GAWOR-BIEDOWA; GAWOR-BIEDOWA, p. 112, pl. 14, fig. 6, text-fig. 9.

Type species figured on pl. XIV, fig. 6a-c (GAWOR-BIEDOWA, 1972) from the Cenomanian of borehole Maszkowo, 214.6 m.

Decsription: test biconvex, involute, with a smooth and lustrous surface. The dorsal side more convex than ventral one, composed of two and a half whorls. Only the last whorl is visible on both its sides, composed of 9-10 chambers. The margin of test narrow, provided with a rounded keel. The chambers of the last whorl in the initial part low or slightly convex and at the end high, conical, convex. Sutures subradial, narrow, between three to four chambers are depressed. In the middle of the dorsal side there is a large, lustrous boss occupying about one-third of the surface of test. Ventral side feebly convex or flat with hook-like thickening occurring in its middle. Lamellar flaps of the chambers arranged in a starlike pattern around the umbilicus. Aperture arcuate, extended into the ventral side.

Remarks: 15 individuals from the Upper Cenomanian and 21 individuals from the Lower Turonian sediments were studied. Well preserved tests correspond with the original description of the species. The individual variability is manifested by a varying convexity of the test on the dorsal side and a varying degree of the depression of sutures.

Distribution: NW and central part of Poland - Upper Albian to Lower Turonian;

Bohemian Cretaceous: Cenomanian of borehole DB-1; Lower Turonian of boreholes Lib-1, Sli-1, DB-1, Sk-28, KN-3.

Recommended for print by J. Salaj
Translated by P. Hradecký

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Gavelinella Brotzen, 1942 a Lingulogavelinella Malapris, 1969 (Foraminifera) z české křídové pánve

(*Résumé anglického textu*)

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Foraminifery skupiny gavelinel tvoří výraznou složku svrchnokřídového foraminiferového společenstva české křídové pánve. Během dlouhého období výzkumu této skupiny k ní byly řazeny rozličné formy, takže její klasifikace byla dost obtížná.

Na základě špatné interpretace některých znaků na schránkách byly stanoveny různé rody, podrody nebo poddruhy, které se ukázaly být v pozdějších výzkumech neplatné, neboť se zjistilo, že stránky mají mnoho znaků variabilních, a proto nevhodných pro charakteristiku taxonů. Bylo nutné zaměřit pozornost i na vnitřní strukturu schránek, která tak snadno nepodléhá vlivům okolního prostředí.

Z oblasti české křídové pánve byla provedena revize taxonomického zařazení a podrobné systematické zpracování obou příbuzných rodů zastoupených 15 druhy rodu *Gavelinella* a 4 druhy rodu *Lingulogavelinella*. Při systematickém zpracování druhů jsem se přidržela klasifikace LOEBLICHA A TAPPANOVÉ (1964, 1974).

V kapitole o fylogenezi byl nastíněn pravděpodobný vývoj této skupiny v oblasti české křídové pánve. Tento vývoj je srovnatelný s vývojem v oblasti německo-polské křídové pánve, ale i anglo-pařížské pánve. Na základě vlastního pozorování byly některé vývojové řady navržené dřívějšími autory (MICHAEL 1966, EDWARDS 1981, CARTER a HART 1977) doplněny o další členy na základě podobnosti v morfologii schránky a provedených měření. Pro formy s téměř kulovitými komůrkami jsem navrhla samostatnou vývojovou řadu *G. polessica - G. moniliformis - G. ukrainica - G. tumida*, s uvedením hlavních změn na schránce během vývoje.

Gavelinely jsou zastoupeny ve všech stratigrafických úrovních svrchní křídy, některé druhy jsou považovány i za vůdčí pro určitou stratigrafickou jednotku. Mnohé z nich jsou důležitou součástí foraminiferových zón v okolních evropských pánvích. Všeobecně je však tato skupiny bentózních foraminifer značně ovlivňována změnami životního prostředí, a proto mají druhy skupiny často jen regionální význam, který však není při studiích v oblasti jedné sedimentační pánve zanedbatelný.

Značná pozornost byla věnována paleoekologii a paleogeografii nejrozšířenějších gavelinel v oblasti české křídové pánve, s úvahami o příznivých nebo méně příznivých životních podmínkách ovlivňujících vývoj druhu. Na základě měření značného počtu schránek gavelinel v jednotlivých litologických typech sedimentů byl studován vliv charakteru sedimentů na velikost schránek.