PLANKTONIC FORAMINIFERA OF THE PÉNZESKÚT MARL FORMATION (ALBIAN-CENOMANIAN), TRANSDANUBIAN MIDMOUNTAINS, HUNGARY. PART I: THE JÁSD J–42 STRATOTYPE PROFILE

by

I. BODROGI

Hungarian Geological Institute, Budapest

(Received: 1st April, 1987)

Abstract

The planktonic foraminifer fauna of the Pénzeskút Marl is described, providing stratigraphical and ecological interpretation. A short introduction to the geology of the formation is given. First and last occurrences and quantitative distribution of the fauna in the Jásd–42 borehole are described in detail. Two zones and two subzones were recognized: 1. Rotalipora appenninica Zone (a: R. ticinensis – Planomalina buxtorfi Subzone; b: R. appenninica – Guembelitria cenomana Subzone; Lower and Upper Vraconian, respectively); 2. Rotalipora brotzeni Zone: Lower Cenomanian.

Introduction

This paper is the result of the author's participation in the National Key Section Programme and in the International Geological Correlation Programme, Project 58, during the years 1979–1984.

Stratigraphy of the Pénzeskút Marl is based on ammonite studies of SCHOLTZ (1973, 1979) and HORVÁTH (1985). Planktonic foraminifers were studied by MAJZON (1940, 1966) at the first time. SIDÓ recognized foraminifer assemblages, planktonic zones and benthonic biofacies horizons (SIDÓ, 1966, 1971).

The Middle Cretaceous sedimentary cycle of the Transdanubian Midmountains consists of 6 formations (Fig. 1). The Pénzeskút Marl is the youngest member of the cycle. It occupies a narrow zone along the axis of the Midmountains syncline, of about 60 km length and 3–10 km width (Fig. 2). Thickness extends up to 476 m (Jásd–42 borehole), divided into three subunits (after CSÁSZÁR, 1985; Fig. 3). The lower subunit is made of 140 m dolomitic silty marl with calcareous nodules. Its lowermost, 0,5 to 1 m thick bed is a glauconitic horizon, the glauconite content swiftly decreasing upwards. It contains 0.2 to 0.6 m thick breccia made of the underlying limestone and fossil fragments. The 199 m thick middle subunit is poorly bedded, dark gray dolomitic marl, while the upper, 145 m thick subunit is characterised by alternating dolomitic, silty marl, siltstone and sandstone.

The Pénzeskút Marl is underlain by the Zirc Limestone, usually by a hiatus, but deposition was uninterrupted in the southwest.

* Doctoral thesis defended at Eötvös University.

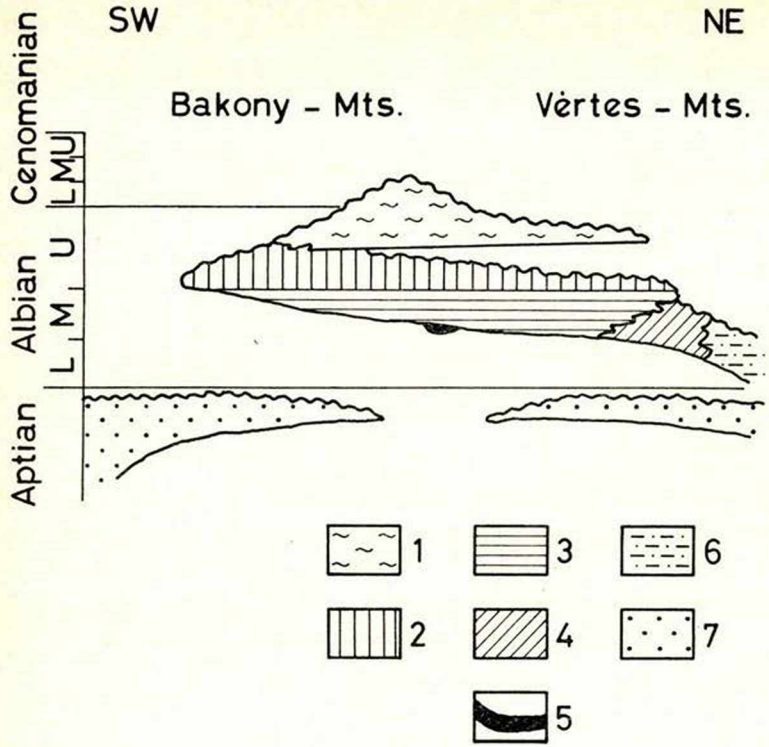


Fig. 1. Aptian-Cenomanian formations of Bakony and Vértes Mts., Legend: 1. Pénzeskút Marl; 2: Zirc Limestone; 3: Tés Marl; 4: Környe Limestone; 5: Alsópere Bauxite; 6: Vértessomló Siltstone; 7. Tata Limestone.

The Jásd – 42 stratotype profile

About 200 forms were recognized in the extremely rich foraminifer fauna, 134 of which were determined to the species level.

Mode of life of the genera and species

	Genera	Species
Planktonic	8: 15,3%	22: 15,7%
Calcareous benthonic	30: 56,6%	78: 58,2%
Agglutinated benthonic	15: 28,1%	35: 26,1%

Age of the planktonic foraminifer species

Individuals of the genera *Rotalipora*, *Hedbergella*, *Globigerinelloides*, *Praeglobotruncana*, and *Planomalina* dominate the planktonic fauna. The benthonic groups with great diversity, but less individuals has a more significant facies indicator role.

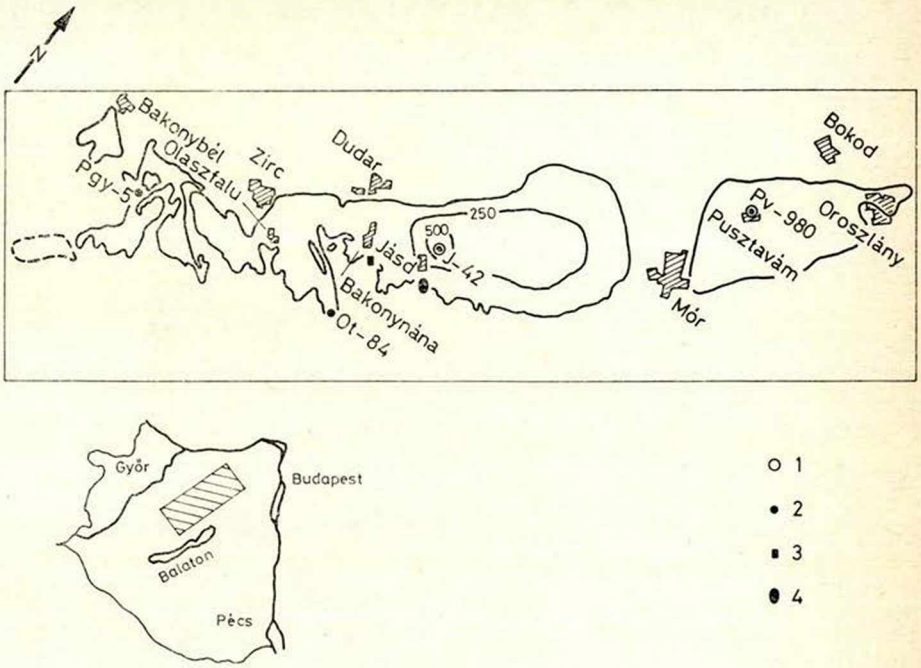


Fig. 2. Location of the investigated sections. Legend: 1: borehole stratotype; 2: borehole reference section; 3: surface boundary stratotype; 4: surface reference section.

Table I.

Appearance	Number	Percentage
Lower Cretaceous	7	31,81%
Lower Albian	4	18,18%
Lower Vraconian	6	27,27%
Upper Vraconian	3	13,65%
Lower Cenomanian	2	9,09%
Total	22	100,00%

Except the lowest metres at the beginning of the transgression and the upper 135 metres, interpreted as a regressive facies, the planktonic fauna is characterised by great diversity, fast evolution of single-keeled Rotaliporas, their increasing species diversity, great number, and extreme intraspecific and interspecific variability.

Range of the species is shown in Fig. 4, while some of them are illustrated on six plates.

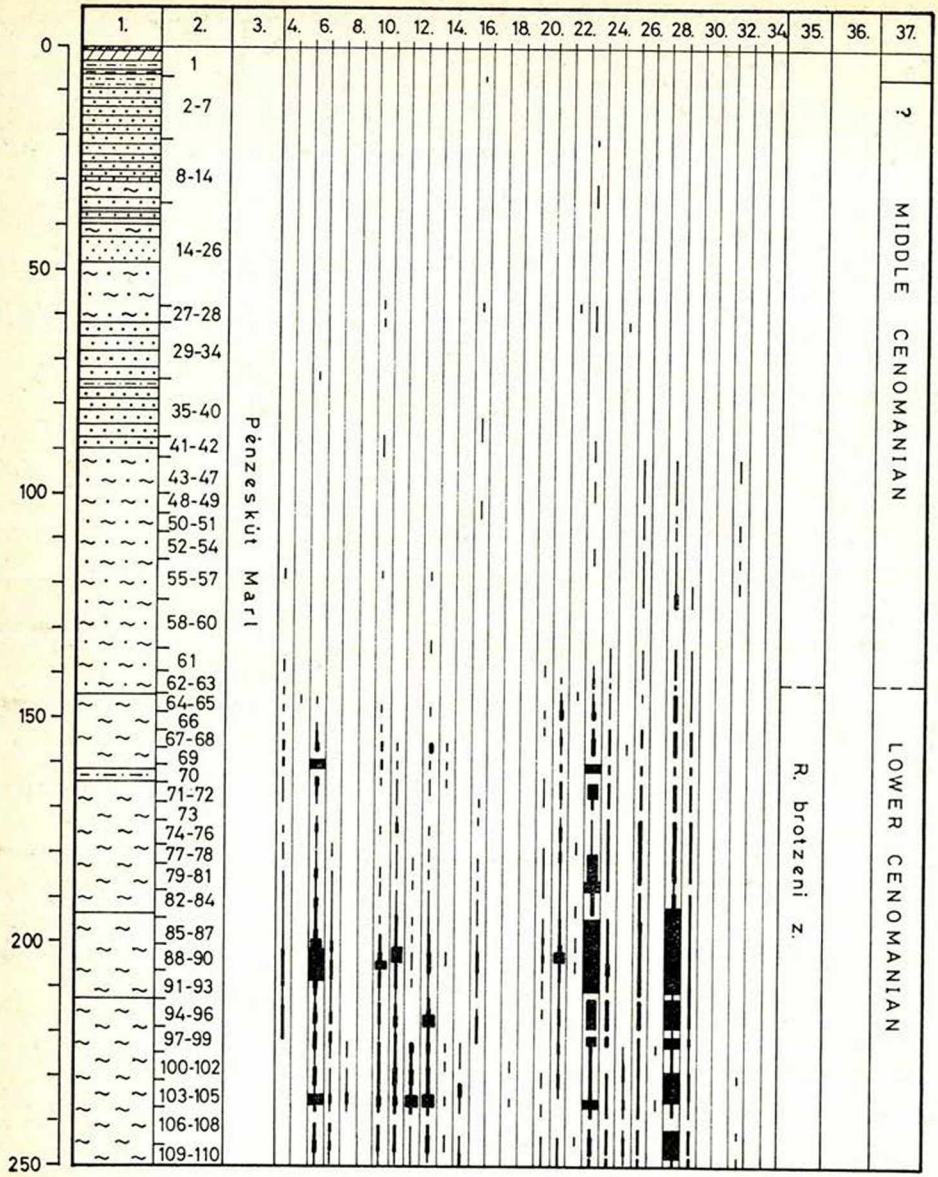
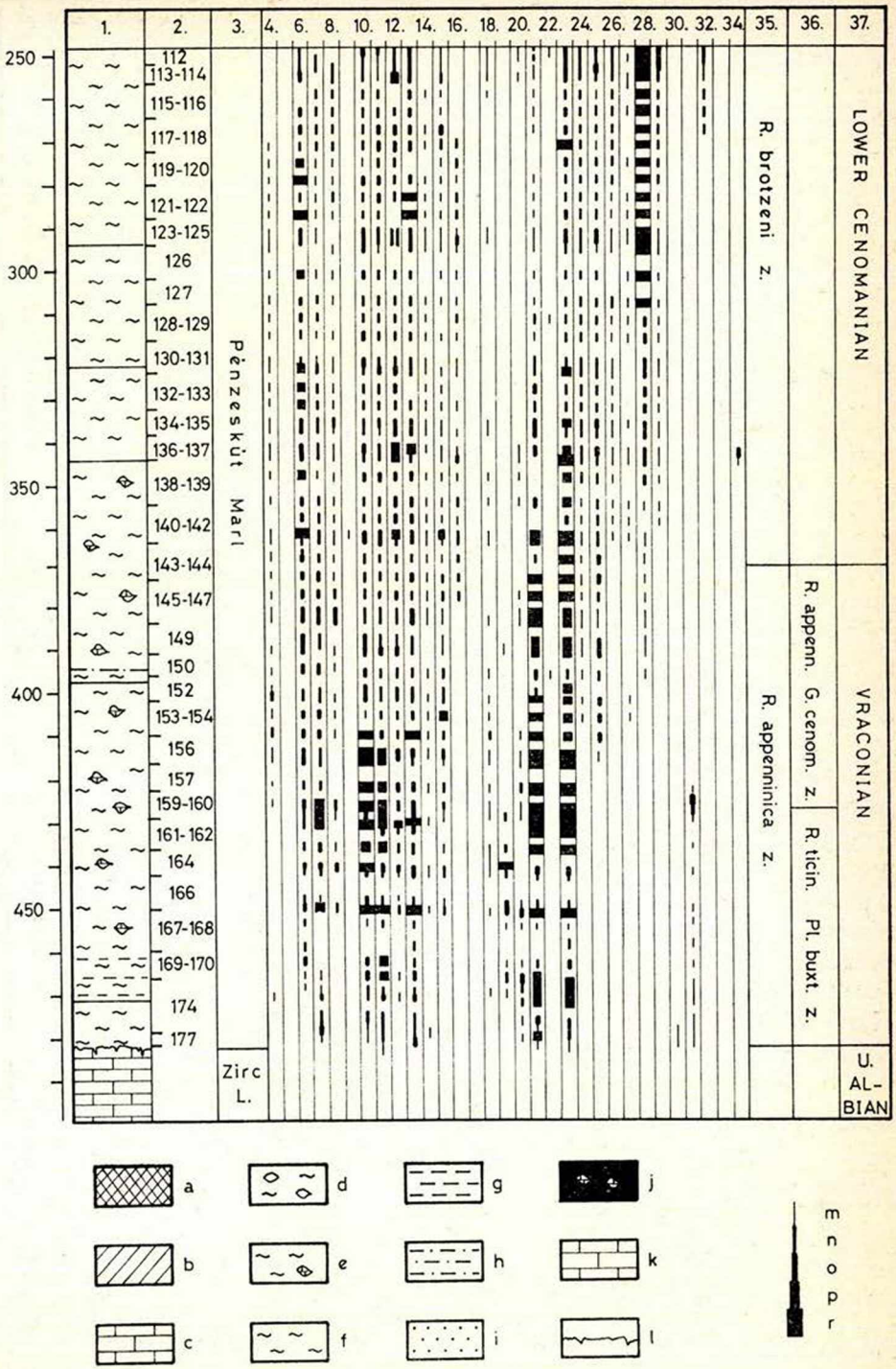


Fig. 3. Planktonic foraminifer fauna of the Jásd – 42 stratotype profile. Legend: 1: stratigraphic column; 2: sampling location (washed samples); 3: lithostratigraphic formations 4: *Favusella (H.) washitensis;* 5: *F.* cf. *washitensis;* 6: *Globigerinelloides bentonensis;* 7: *G escheri;* 8: *G.* sp.; 9: *Guembelitria cenomana;* 10: *Hedbergella delrioensis;* 11: *H. infracretacea;* 12: *H. simplex;* 13: *H. trocoidea;* 14: *H. planispira;* 15: *H. brittonensis;* 16: *H.* sp.; 17: *Heterohelix moremanni;* 18: *H. washitensis;* 19: *Planomalina buxtorfi;* 20: *Praeglobotruncana delrioensis;* 21: *P. stephani;* 22: *P.* sp., 23: *Rotalipora appenninica ;* 24: *R. globotruncanoides;* 25: *R. appenninica* var. *evoluta;* 26: *R. brotzeni;* 27: *R.* aff. *brotzeni;* 28: *R. gandolfii;* 29: *R. micheli;* 30: *R. subticinensis;* 31: *R. ticinensis;* 32: *R.* sp., 33: *Ticinella praeticinensis;* 34: *T.* sp.; 35: planktonic foraminifer zones; 36: subzones; 37: geological age.

Fig. 3. (continued)



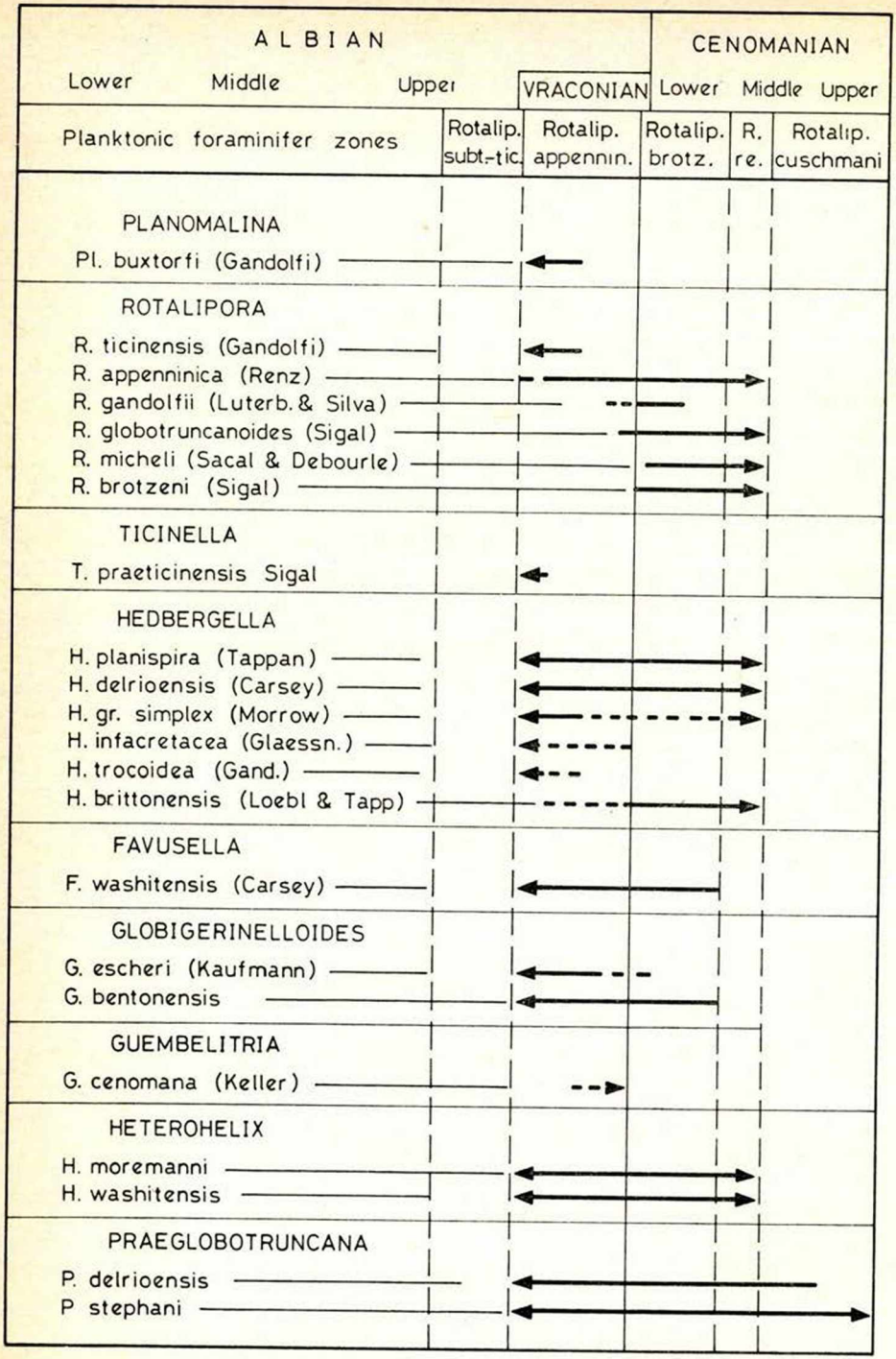


Fig. 4. Stratigraphic range of planktonic foraminifers.

Underlying beds of the Pénzeskút Marl

The Jász – 42 borehole cut below the Pénzeskút Marl the Mesterhajag Member of the Zirc Limestone (lower faunal level, *Orbitolina* limestone, microfauna limestone).

Thin sections of an 1,7 m thick bed (483,1 – 484,8 m) contained *Rotalipora*? sp., *Hedbergella* sp., and *Hedbergella* cf. *planispira* (TAPP.).

Orbitolinas were recognized only in thin sections from the 484,8 – 485,2 m section.

Between 485,2 – 499,0 m there is platform limestone with typical Albian benthonic foraminifer assemblage (*Debarina hahourenensis* FOURCADE et al., *Nezzazata simplex* OMARA, *Nummoloculina heimi* BONET).

Basal beds of the Pénzeskút Marl

Lowermost beds of the Pénzeskút Marl are strongly glauconitic, dolomitic marls (5 m). Members of the genus *Rotalipora* appear from 483,1 m onwards: *Rotalipora ticinensis* (GANDOLFI), *R. appenninica* (RENZ) *primitiva* (BORSETTI), *Rotalipora* sp. The species *Planomalina buxtorfi* (GANDOLFI) appears at 479,0 m. In the redeposited material of the underlying Zirc Limestone *Rotalipora subticinensis* (GANDOLFI) was recognized (477,0 m).

Specimens of *Rotalipora appenninica* (RENZ) and *Rotalipora appenninica* (RENZ) *primitiva* BORSETTI are sporadic, small, strongly papillated, of primitive, archaic character. Specimens of *Planomalina buxtorfi* (GANDOLFI) are also small.

The associated planktonic assemblage contains *Hedbergella (infracretacea, delrioensis, planispira)*, *Globigerinelloides (escheri)*, *Praeglobotruncana (delrioensis)*, and *Favusella (washitensis*, cf. *washitensis)* species. All of them are older, Aptian-Albian transition forms. About 9 m above the boundary (476,0 m) sharply increases the diversity of the plankton, including the zonal index forms.

Planktonic foraminifer zonation

The planktonic foraminifers are represented by 8 genera[*Globigerinelloides*, *Hedbergella (Clavihedbergella)*, *Heterohelix*, *Guembelitria*, *Planomalina*, *Praeglobotruncana*, *Rotalipora*], *Ticinella* and 22 species (BODROGI, 1985). The single-keeled *Rotalipora* species with swift evolution, *Planomalina buxtorfi*, and *Guembelitria cenomana* species were applied for zonation. Two zones and two subzones were recognized, and an upper, regressive series, unsuitable for zonation (Fig. 5).

1. Rotalipora appenninica Zone (363,0 – 483,1 m)
   Thickness: 120,1 m
   Age: Vraconian

1/a. Rotalipora ticinensis – Planomalina buxtorfi Subzone (427,0 – 483,1 m)
   Thickness: 56,1 m
   Age: Lower Vraconian

ACE		Ammonite zones: JUIGNET 1976, 1978 Type region Sarthe	Ammonite zones: A. Horváth 1982 (J–42)	Planktonic foraminifer zones: Robaszynski et Coron 1979	Planktonic foraminifer zones: Wonders 1980 Sigal 1977	Planktonic foraminifer zones: Bodrogi I. 1982 (J–42)		← first → last occurrences of forams
CENOMANIAN	UPPER	Sciponoceras gracile		W.arch	W.arch			R.cushmani →
		Eucalicoceras pentogonum		Rotalipora cushmani	Rotalipora cushmani			R.brotzeni → R.monts. → R.appenninica → R.reicheli →
	MIDDLE	Acanthoceras jukes brownei						
		T.acutus						← R.cushmani
		Turr. costatus	A.rothomagense	Rotalipora reicheli		Regression ?		← R.reicheli ← R.montsalv.
	LOWER	Mant.dixoni	M.mantelli	Rotalipora brotzeni	Th. globotruncanoides	Rotalipora brotzeni		← R.brotzeni ← R.globotrunc.
		Mant. saxbii						
		Hypoturr carr itanensis						
UPPER ALBIAN	VRACONIAN	St.dispar bergeri / blanchetti	St.dispar bergeri / blanchetti	Rotalipora appenninica	Th.appenninica	Rotalipora appenninica	R.appenninica et Guembelitria cenomana	Pl.buxtorfi → R.ticinensis →
					Th.app.-Pl buxt.			
					Ps.ticin. Pl.praegbuxt		R.ticinensis Pl.buxtorfi	← Pl. buxtorfi
		M.inflatum			Ps.subticinensis			← R.appeinninca ← Prglobotr. ← R.ticinensis

Fig. 5. Ammonite and foraminifer zones of the Pénzeskút Marl.

1/b. Rotalipora appenninica – Guembelitria cenomana Subzone
(363,0 – 327,0 m)
Thickness: 61,4 m
Age: Upper Vraconian

2. Rotalipora brotzeni Zone (141,0 – 363,0 m)
Thickness: 222,0 m
Age: Lower Cenomanian

The uppermost, about 135 m thick section is interpreted as a regressive series.

Phylogenetic relationships of and the biozones based on the *Rotalipora* species are displayed on Fig. 6.

Characteristics of the zones

1. Rotalipora appenninica Zone
Lower boundary: appearance of *Rotalipora appenninica* (RENZ).
Age: Vraconian (Upper Albian)
Section: 363,0 – 483,1 m.
Thickness: 120,1 m
Planktonic foraminifer species:

Globigerinelloides bentonensis (MORROW, 1934)
Globigerinelloides escheri (KAUFMANN, 1919)
Guembelitria cenomana (KELLER, 1938)
Hedbergella delrioensis (CARSEY, 1936)
Hedbergella brittonensis (LOEBLICH ET TAPPAN, 1961)
Favusella (H.) washitensis (CARSEY, 1926)
Hedbergella aff. trocoidea (GONDOLFI, 1942)
Hedbergella planispira (TAPPAN, 1940)
Heterohelix moremanni (CUSHMAN, 1938)
Planomalina buxtorfi (GANDOLFI, 1942)
Praeglobotruncana delrioensis (PLUMMER, 1931)
Praeglobotruncana stephani (GANDOLFI, 1942)
Rotalipora appenninica (RENZ, 1936)
Rotalipora globotruncanoides (SIGAL, 1942)
Rotalipora ticinensis (GANDOLFI, 1942)
Rotalipora gandolfii LUTERBACHER et PREMOLI SILVA, 1962
Ticinella praeticinensis SIGAL, 1966

Zonation is based on the following species:
Rotalipora appenninica (RENZ, 1936)
Rotalipora ticinensis (GANDOLFI, 1942)
Rotalipora globotruncanoides (SIGAL, 1942)
Rotalipora gandolfii LUTERBACHER et PREMOLI SILVA, 1962
Planomalina buxtorfi (GANDOLFI, 1942)

This zone, enclosing the about 120 m thick lower section of the borehole (lithostratigraphic unit No. 1) is made of dark grey, dolomitic limestone, calcareous marl, nodular marl; the lowest 5 m section is strongly

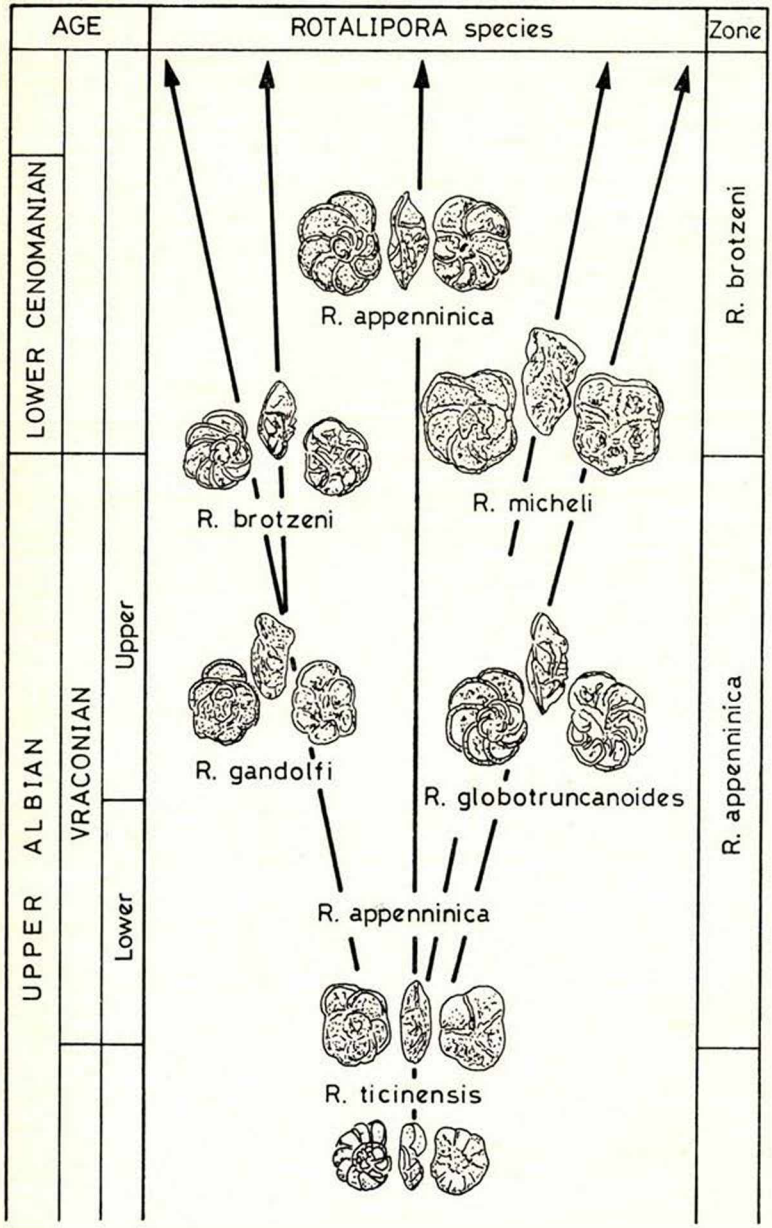


Fig. 6. Phylogenetical relationships of *Rotalipora* species.

glauconitic. The lower boundary of the biozone and the lithostratigraphic unit is equal. At the upper boundary, where no sharp lithological change was observed, the planktonic foraminifer fauna changes with 19,3 m difference.

The zone index *Rotalipora appenninica* (RENZ) appears in the first sample, but sporadically only. This variable species with high diversity appears from 450 m in most samples in great quantities. Its intraspecific variability is extremely high. In the lower part of the zone (1/a subzone) the species is represented by the small, primitive, strongly papillated *Rotalipora appenninica* (RENZ) *primitiva* BORSETTI and the *Rotalipora balernaensis* (GANDOLFI) with flat dorsal side, the latter being synonymous with the former one since 1969. Besides the typical specimens of *Rotalipora appenninica* (RENZ) occur, too (Fig. 7).

In the upper part of the zone (1/b subzone) the intraspecific variation increases: flat, conical, nearly symmetrical and variably asymmetrical forms appear.

Near the subzone boundary some species of Rotalipora appenninica bear thickening of the suture on the ventral chambers, developing into praeumbilical keel (WONDERS, 1978). Besides the regular right coiling, some left-coiling specimens occur.

Besides the older, involute varieties there are evolute types with elongated last chamber (1/b subzone), represented by the synonymous *Rotalipora evoluta* SIGAL, appearing at 415 m. It is frequent in 1/b subzone and at the bottom of the Rotalipora brotzeni Zone.

The small, globular, weakly keeled forms are atavistic, indicating the *Rotalipora ticinensis* – *Rotalipora subticinensis* lineage.

Chamber surface of *Rotalipora appenninica* and its variations change from strong papillation towards a smooth surface. The suture pattern of the dorsal side, with 90° angle or very near to it, is an important, Mediterranean character. The diameter of the test gradually grows: it is about 25 micrometres at the top of the zone, while it is about half of it at the lower boundary.

The species *Rotalipora ticinensis* (GANDOLFI) appears between 420,0 – 438,1 m, between 425,0 – 430,0 m occurring in large numbers. The species *Rotalipora globotruncanoides* appears in the upper part of the zone (405 m), together with *Rotalipora gandolfii* LUTERBACHER and PREMOLI SILVA (402 m), *Rotalipora* aff. *brotzeni* (SIGAL) (400 – 402 m, 220 – 363 m). All three taxa are represented by sporadic specimens only. *Planomalina buxtorfi* (GANDOLFI) appears between 427 – 479 m sporadically, but it is frequent between 440 – 450 m. The boundary of the two subzones was drawn at its last occurrence (427 m).

The genus *Praeglobotruncana*, represented by the species *P. stephani* (GANDOLFI) and *P. delrioensis* (PLUMMER) decrease in number upwards. The former one is frequent up to 460 m, while the latter one is frequent in the lower samples only, decreasing upwards, being sporadic above 421 m.

The unkeeled, globular planktonic group includes the genera *Favusella*, *Hedbergella*, *Globigerinelloides*, *Heterohelix*, *Ticinella*. Most of the *Hedbergella* species are frequent, except the sporadic *H. aff. trocoidea* (GANDOLFI).

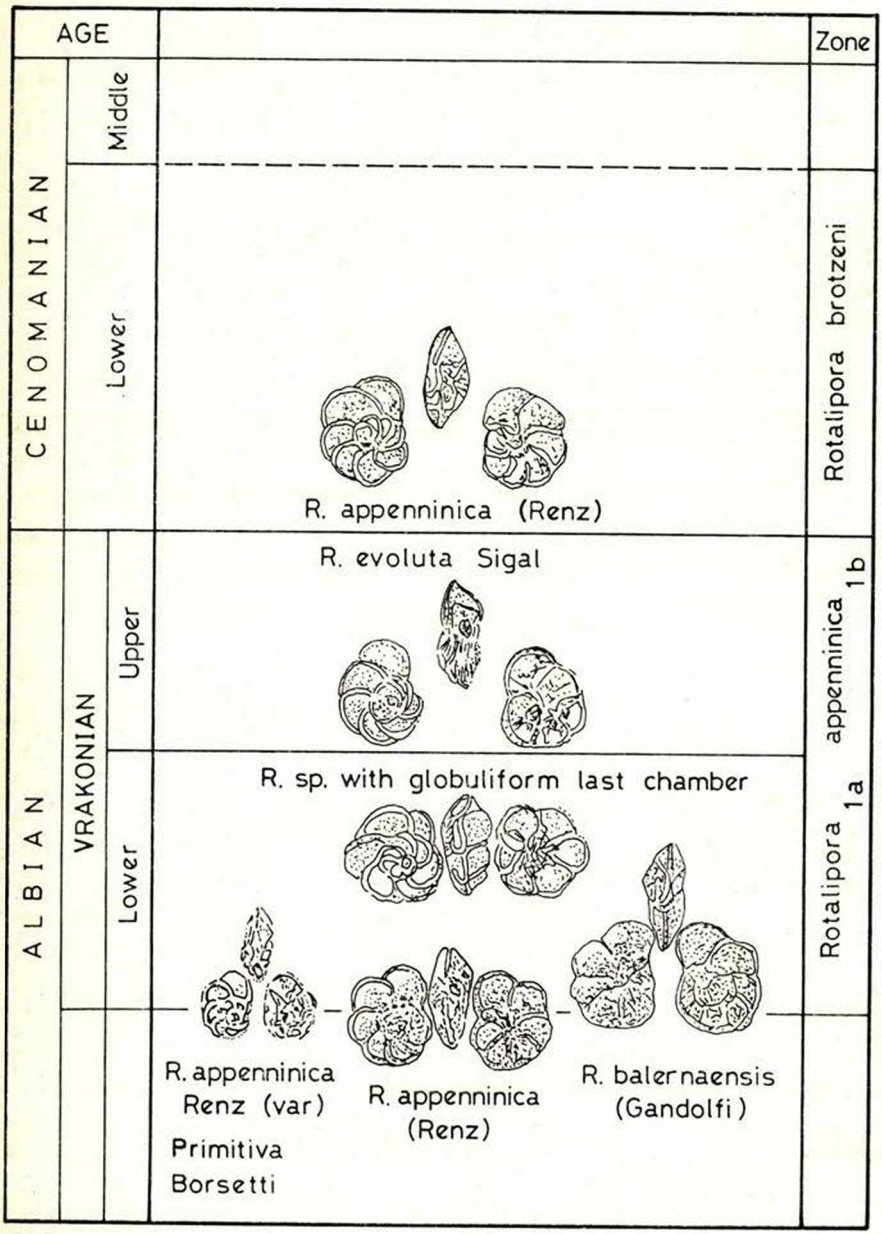


Fig. 7. Intraspecific variations of *Rotalipora appenninica*

The species *Favusella washitensis* (CARSEY), *Heterohelix* species, and *Ticinella praeticinensis* SIGAL are sporadic. Persistent species is *Globigerinelloides escheri* (KAUFMANN). The species *Globigerinelloides bentonensis* (MORROW) appears at 470 m, in middle to frequent numbers. CARTER and HART (1979) considers *Globigerinelloides aeglefordensis* MOREMANN as a junior synonym of *Globigerinelloides bentonensis* (MORROW). The *Guembelitria cenomana* species occurs in one sample only (363 m) as a single specimen.

At the lower and upper boundary of the zone a phylogenetic radiation of the genus *Rotalipora* occurs. At the lower boundary the zonal index *Rotalipora appenninica* appears, evolved from the *Rotalipora ticinensis* branch. Near the upper zone boundary from *Rotalipora appenninica* two species, *R. globotruncanoides* and *R. gandolfii* evolve at the uppermost part of Vraconian, while appearance of *R. brotzeni* indicates Lower Cenomanian (363 m). *R. micheli* appears at the lower part of Lower Cenomanian (358 m).

Subzones of Rotalipora appenninica Zone

1/a. Rotalipora ticinensis – Planomalina buxtorfi Subzone

Lower boundary: appearance of *Rotalipora ticinensis* (GANDOLFI) and *Planomalina buxtorfi* (GANDOLFI).

Upper boundary: disappearance of *Planomalina buxtorfi* (GANDOLFI) and *Rotalipora ticinensis* (GANDOLFI), as no new species appear.

Age: Lower Vraconian
Section: 427,0 – 483,1 m
Thickness: 56,1 m

Characteristic planktonic foraminifer species of the subzone:

Heterohelix moremanni (CUSHMAN, 1938)
Heterohelix washitensis (TAPPAN, 1940)
Planomalina buxtorfi (GANDOLFI, 1942)
Rotalipora appenninica (RENZ, 1936)
Rotalipora ticinensis (GANDOLFI, 1942)

Zonation is based on the following species:

Rotalipora ticinensis (GANDOLFI, 1942)
Rotalipora appenninica (RENZ, 1936)
Planomalina buxtorfi (GANDOLFI, 1942)

Boundary of the two subzones was drawn at the last appearance of *Planomalina buxtorfi* (GANDOLFI) (425 m); *Rotalipora ticinensis* (GANDOLFI) sporadically occurs to about 5 m above the boundary.

Immediately above the boundary no new species appear, but from 415 m onwards *Rotalipora appenninica* (RENZ) var. *evoluta* (SIGAL), a synonym of *R. appenninica* (RENZ) appears.

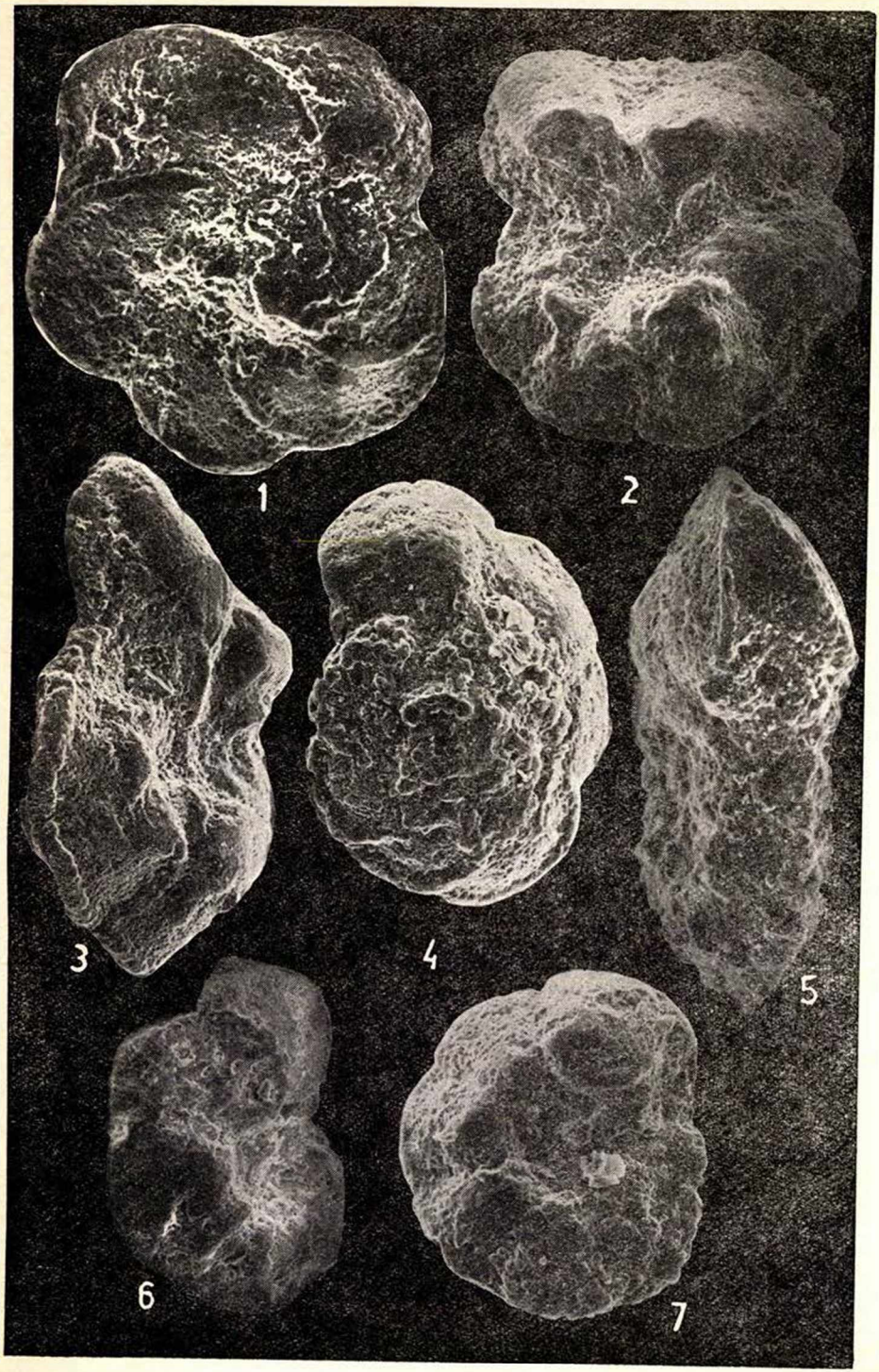

1
2
3
4
5
6
7

PLATE I.

1 – 3. *Rotalipora appenninica* (RENZ)
1.dorsal view; 2. ventral view; 3. lateral view. 120x 249 m

4, 7. *Rotalipora ticinensis* (GANDOLFI)

4. dorsal view 160x 464,5 m

7. ventral view 150x 464,5 m

5 – 6. *Planomalina buxtorfi* (GANDOLFI)

5. lateral view 180x

6. 120x

SEM photographs; Jásd – 42 stratotype borehole

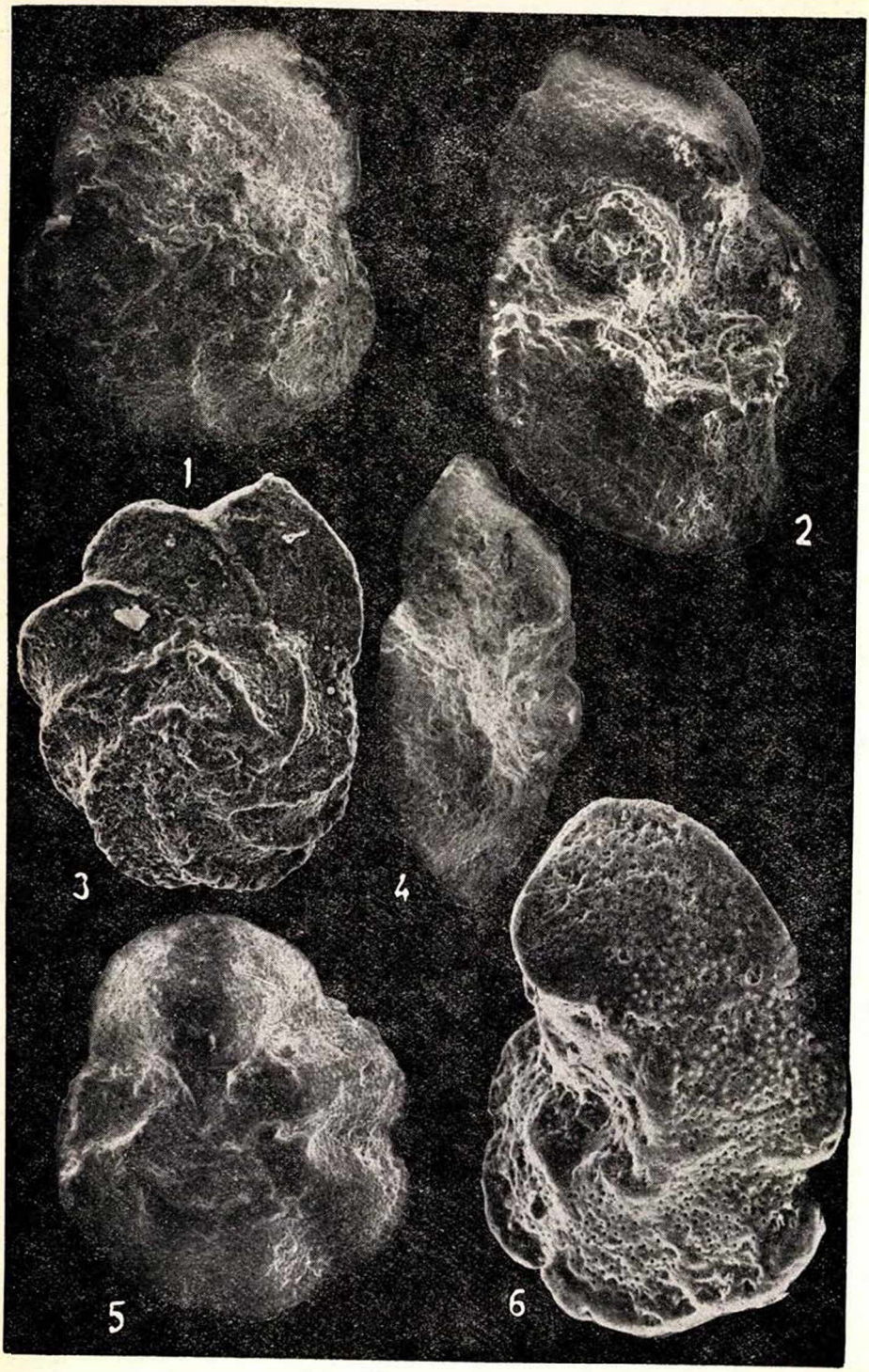

1
2
3
4
5
6

PLATE II.

1, 2, 4. *Rotalipora gandolfii* LUTERBACHER et PREMOLI SILVA

1. dorsal view. 120x
2. ventral view 150x
3. lateral view 120x
   305 m

3, 6. *Rotalipora brotzeni* (Sigal)

3. dorsal view 120x 171 m
6. ventral view 150x 171 m

5. *Rotalipora gandolfii* LUTERBACHER et PREMOLI SILVA
   vental view 120x 305 m

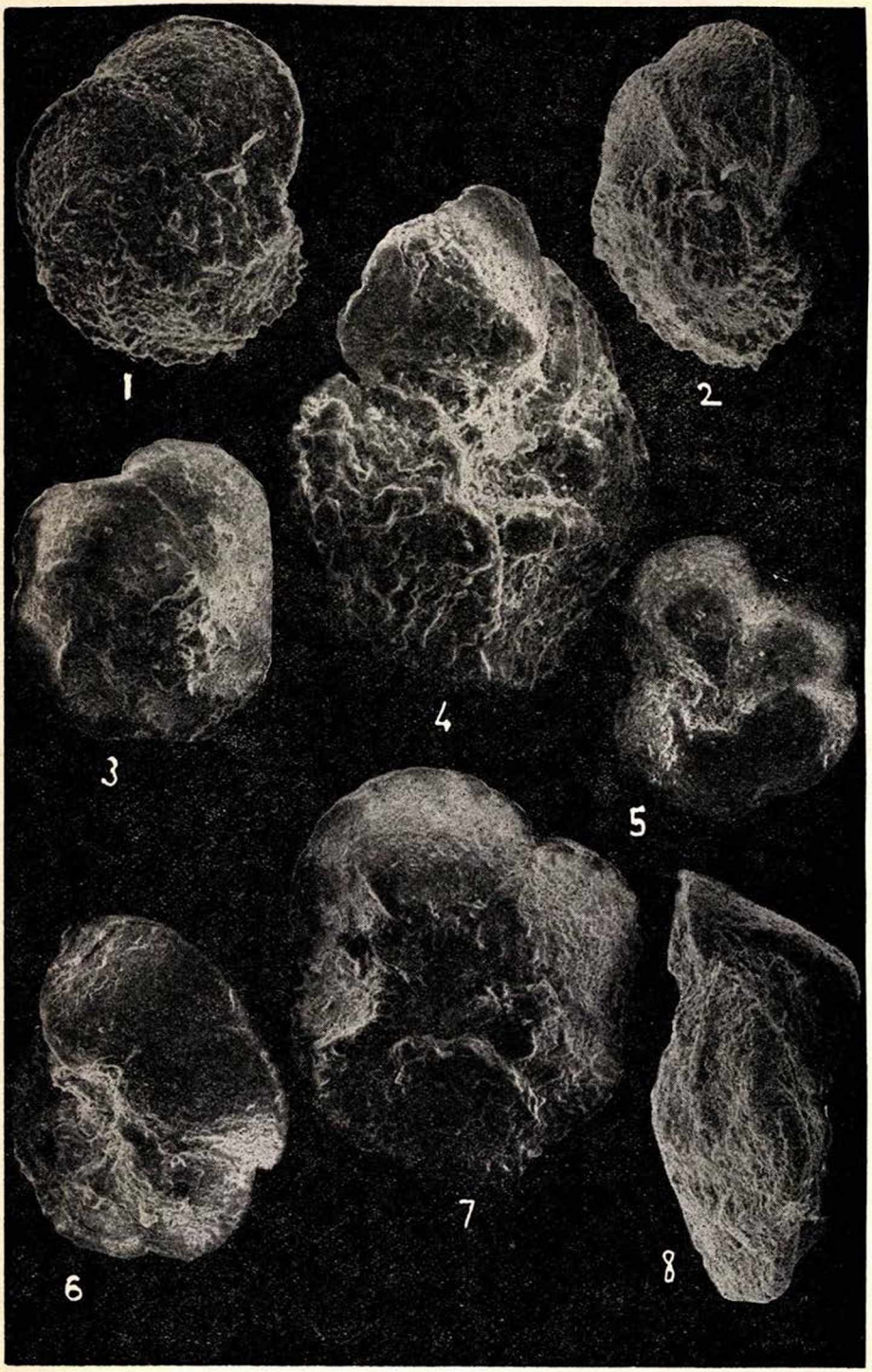

1
2
3
4
5
6
7
8

PLATE III.

1, 2. *Rotalipora appenninica* (RENZ)
primitive type

1. dorsal view. 2. lateral view
150x 469 m

3 – 4, 6 – 7. *Rotalipora brotzeni* (SIGAL)
juvenile specimens, except Fig. 4.

3. dorsal view 200x 171 m

4, 7. ventral views 120x 171 m

6. ventral view 20x 171 m

8. *Rotalipora globotruncanoides* (SIGAL)
177 m 200x

SEM photographs, Borehole Jásd – 42

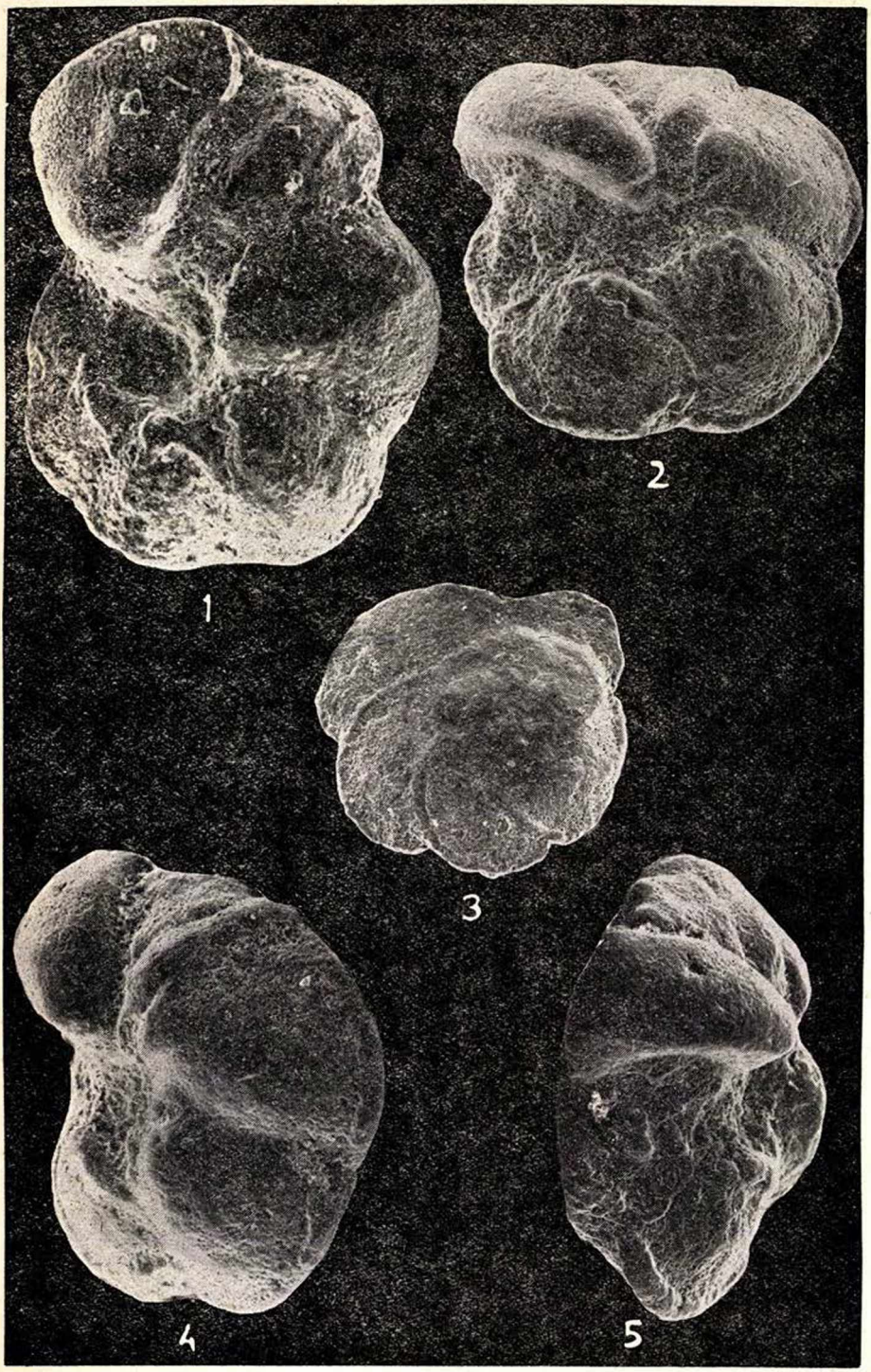

1
2
3
4
5

PLATE IV.

1. *Rotalipora appenninica* (RENZ)
ventral view 130x 293 m

2 – 5. *Rotalipora micheli* (SACAL et DEBOURLE)

2. ventral view, 3. dorsal view, 4 – 5. lateral views.

3.: 100x, 2,4. 5: 130x 177 m

SEM photographs, Jásd – 42 stratotype borehole

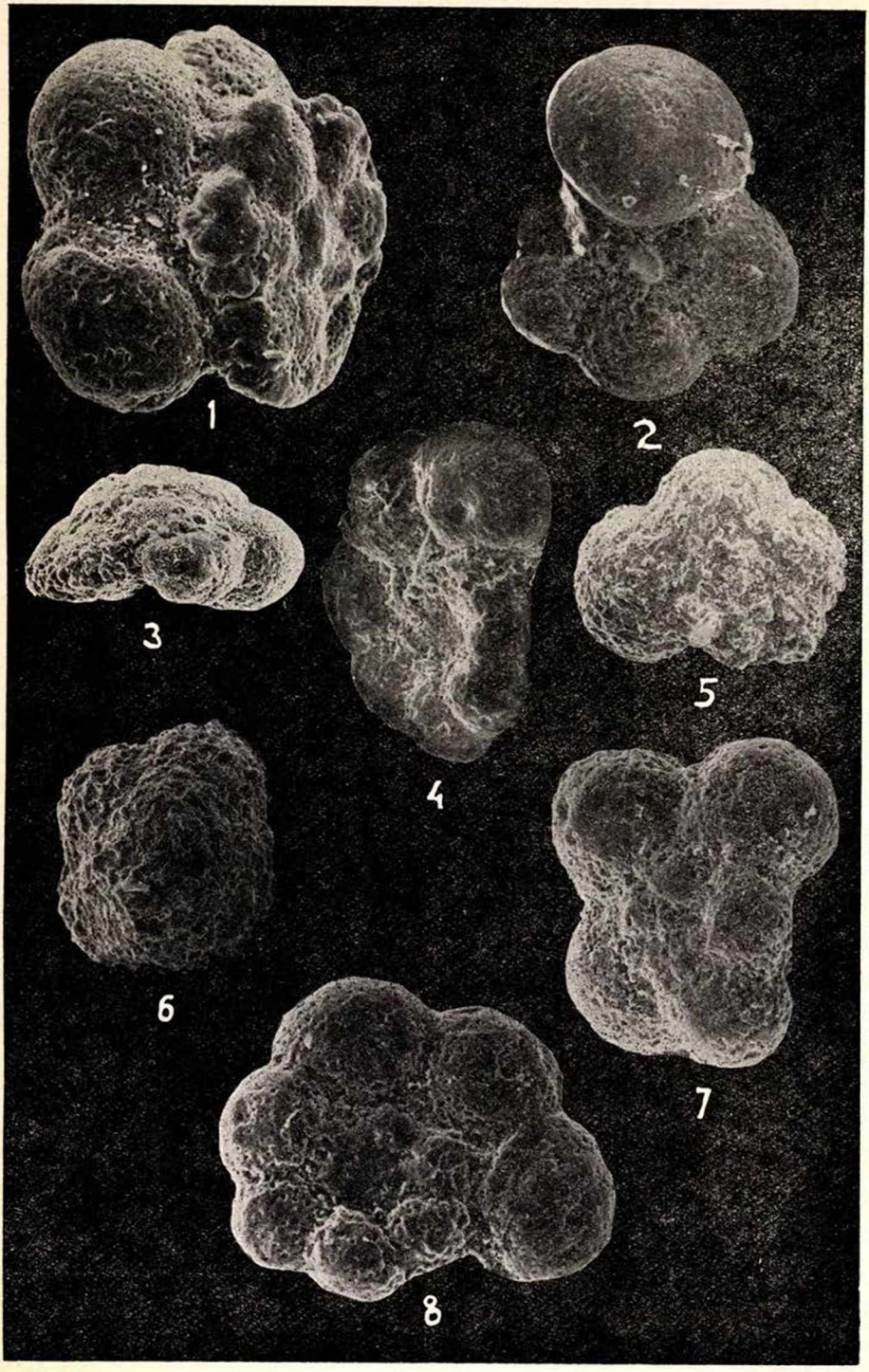
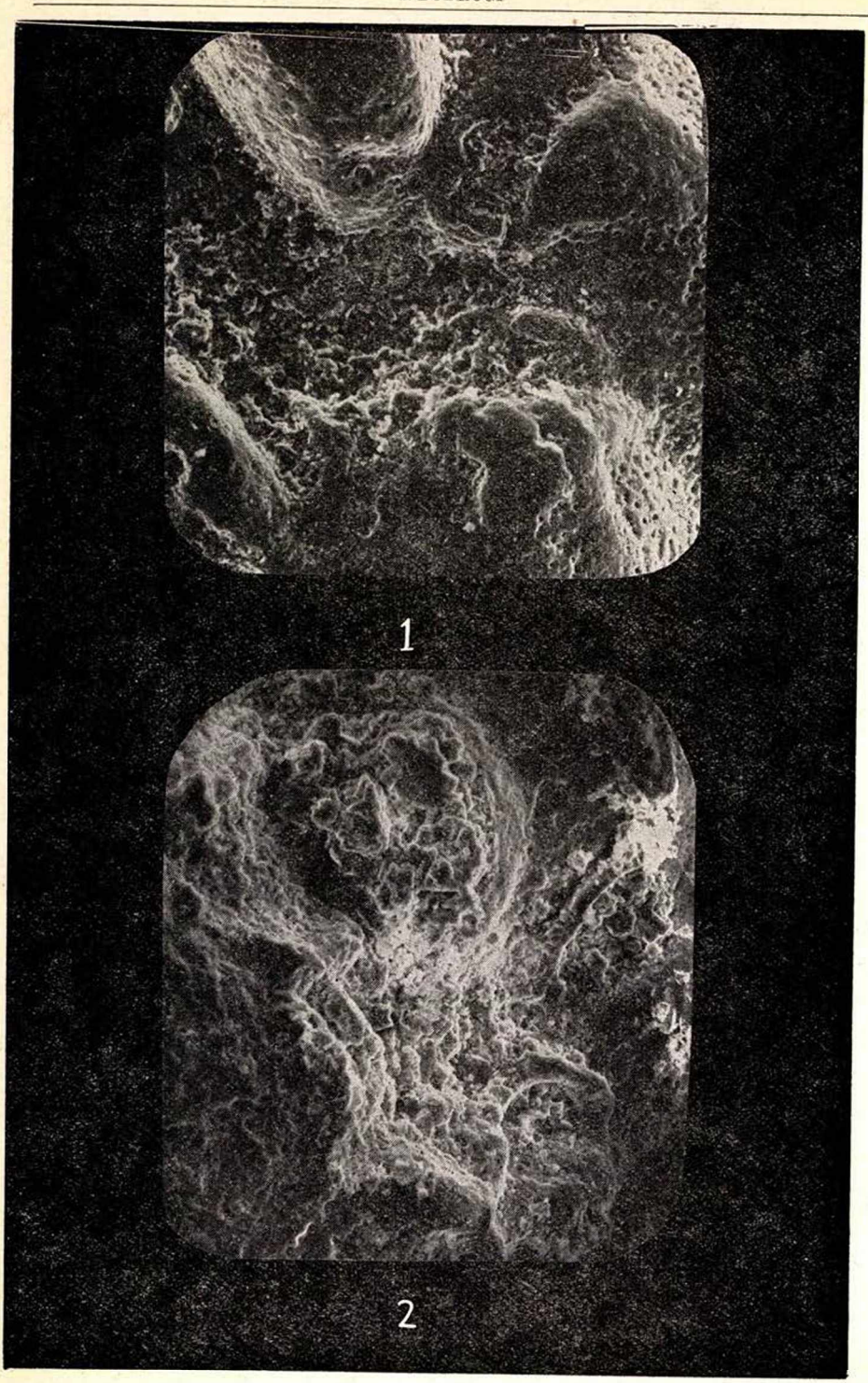

1
2
3
4
5
6
7
8

PLATE V.

1. *Praeglobotruncana delrioensis* (PLUMMER)
dorsal view, 100x, 171 m
2. *Globigerinelloides bentonensis* (MORROW)
171 m, 200x
3. *Praeglobotruncana stephani* (GANDOLFI)
lateral view, 449 m, 100x
4. *Globigerinelloides bentonensis* (MORROW) – aeglefordensis type
171 m, 150x
5. *Hedbergella delrioensis* (CARSEY)
dorsal view, 427 m, 200x
6. *Favusella washitensis* (CARSEY)
dorsal view, 47 m, 100x
7. *Hedbergella simplex* (MORROW)
dorsal view, 427 m, 120x
8. *Hedbergella planispira* (TAPPAN)
dorsal view, 171 m, 130x

SEM photographs, Jásd–42 stratotype borehole



1

2

PLATE VI.

1. *Rotalipora appenninica* (RENZ)
umbilical region with secondary apertures, and thickening of sutures on older chambers
295 m, 400x

2. *Rotalipora gandolfii* LUTERBACHER et PREMOLI SILVA
umbilical region with the main aperture, with secondary apertures, and with umbilical thickening on the chambers
Part of Plate II, fig. 2. 400x 305 m

SEM photographs, Jásd – 42 stratotype borehole

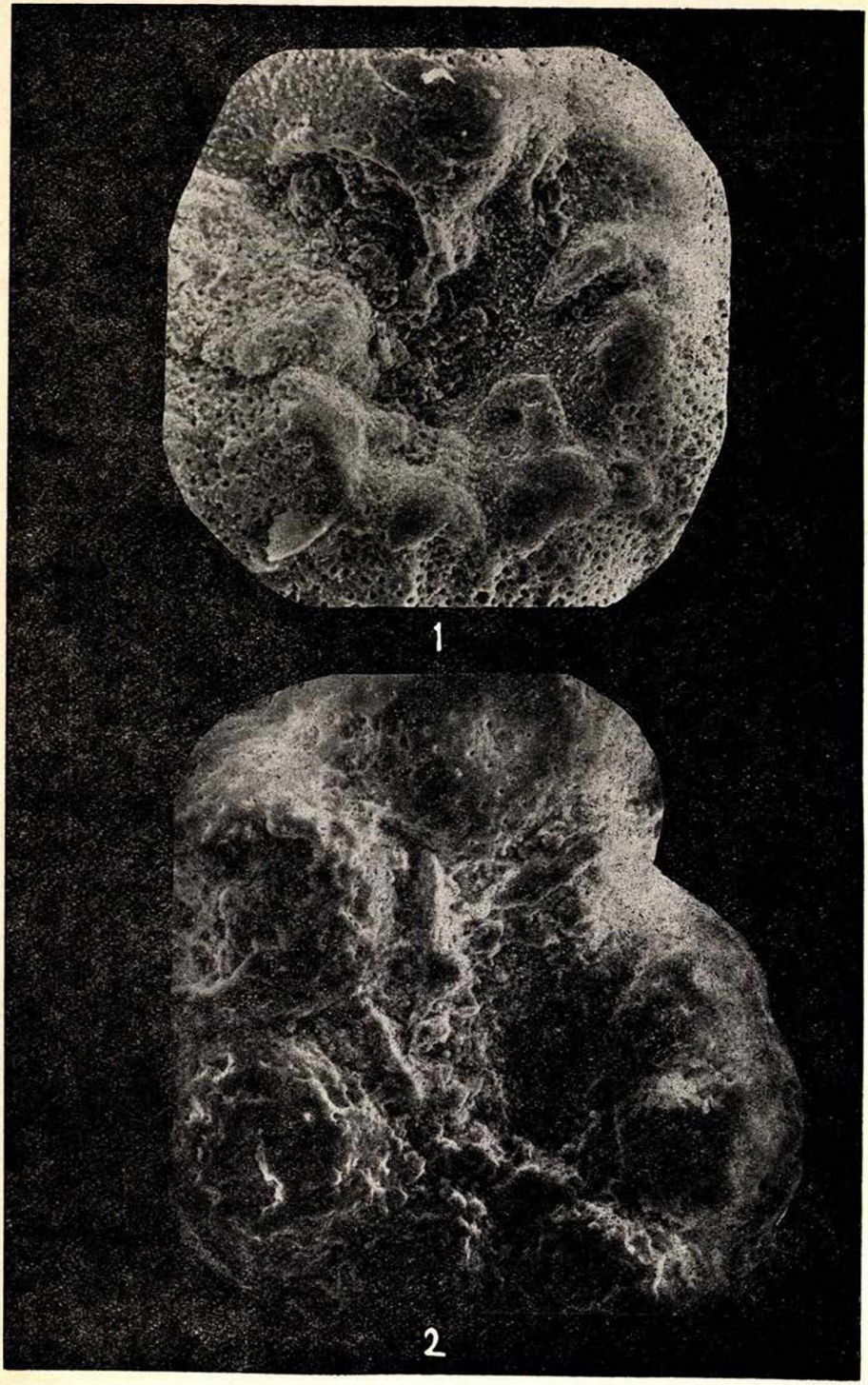

1
2

PLATE VII.

1. *Rotalipora brotzeni* (SIGAL)
umbilical region with main aperture, with secondary apertures and umbilical ring
171 m, 400x

2. *Globigerinelloides bentonensis* (MORROW)
umbilical region with secondary apertures and main aperture
171 m, 480x

SEM photographs, Jásd – 42 stratotype borehole

Photographs: Takács and Bodrogi, laboratory works: Pellérdy

1/b. Rotalipora appenninica – Guembelitria cenomana Subzone

Lower boundary: disappearance of *Planomalina buxtorfi* (GANDOLFI) and *Rotalipora ticinensis* (GANDOLFI)

Upper boundary: apperance of *Rotalipora brotzeni* (SIGAL)
Section: 363,0 – 427,0 m
Age: Upper Vraconian
Thickness: 64 m

Zonation was based on the following species:

Guembelitria cenomana (KELLER, 1938)

Rotalipora appenninica (RENZ, 1936)

Rotalipora globotruncanoides (SIGAL, 1948)

Rotalipora gandolfii LUTERBACHER et PREMOLI SILVA, 1962

Separation of the two subzones is problematic; we could not carry out the separation by apperance of new species, as designated by the Subcommission on Cretaceous Stratigraphy (BIRKELUND, 1983). Without appearing new species, two disappearing species, *Rotalipora ticinensis* (GANDOLFI) (disappears at 420 m), *Planomalina buxtorfi* (GANDOLFI) (disappears at 425 m), and appearance of a conspicuous variation of *Rotalipora appenninica* (RENZ), the *R. appenninica* (RENZ) var. *evoluta* (SIGAL) (415 m) represents the boundary of the two subzones, containing 10 metres of marl. The middle of this section (about 421 m) is very near to the lower boundary of the ammonite subzone (422, 5 m)

Lower boundary of Rotalipora appenninica Zone is the same as the lower boundary of 1/a subzone, while its upper boundary equals with the upper boundary of 1/b subzone.

2. Rotalipora brotzeni Zone

Lower boundary: appearance of *Rotalipora brotzeni* (SIGAL)
Upper boundary: not determined due to facies change
Age; Lower Cenomanian
Section: 141,0 – 363,0 m
Thickness: 222,0 m

The zone contains the middle lithostratigraphic unit of Pénzeskút Marl: dark grey dolomitic marl (293,4 – 363,0 m), dark grey dolomarl (145,0 – 293,0 m), and the lowest 4 metres of the upper lithostratigraphic unit: dolomitic, silty marl with clayey marl intercalations. Lithological change is continuous in the two zones; above 145 m pelitic sedimentation is gradually changed to clastic deposition.

The very rich foraminifer fauna consists of 15 planktonic species of high diversity and in large numbers.

Planktonic foraminifer species:

Globigerinelloides bentonensis (MORROW, 1934)
Globigerinelloides escheri (KAUFMANN, 1919)
Favusella (H.) washitensis (CARSEY, 1926)
Hedbergella delrioensis (CARSEY, 1926)
Hedbergella brittonensis (LOEBLICH ET TAPPAN, 1961)
Hedbergella planispira (TAPPAN, 1940)
Heterohelix washitensis (TAPPAN, 1940)
Heterohelix moremanni (CUSHMAN, 1938)
Praeglobotruncana delrioensis (PLUMMER, 1931)
Praeglobotruncana stephani (GANDOLFI, 1942)
Rotalipora appenninica (RENZ, 1934)
Rotalipora globotruncanoides (SIGAL, 1942)
Rotalipora micheli (SACAL et DEBOURLE, 1957)

Rotalipora brotzeni (SIGAL, 1948)

The zonation is based on *Rotalipora brotzeni* (SIGAL, 1948). Lower boundary is drawn at its first appearance. Its diversity is low, the specimens are small but easily recognizable.

The evolution of the fauna is continuous, no sudden changes were recognized. First overview of the material indicated a monotonous series of samples. Detailed examination revealed a multitude of transitional forms between the well-defined species, with divergences form the type species, trends in variation and morphological varieties.

The zone cannot be subdivided by the appearance or disappearance of species; however around 250 m large size *Rotalipora appenninica* (RENZ) varieties appear with flat dorsal side, and coarsely ornamented *Favusella washitensis* (CARSEY) appear.

With the beginning of clastic sedimentation (between 141 – 208 m) the fauna became poorer in specimens, while above 141 m taxa began to disappear, together with decrease in size.

A new species, *Rotalipora montsolvensis* (MORNOD, 1950), common in the upper two thirds of the Rotalipora brotzeni Zone, was not found in our material. Probably, the facies change has began before its appearance (BODROGI, 1985).

The regressive series

is represented by the Jásd Sandstone (6,9 – 141 m). Its foraminifer fauna contains poorly preserved forms of the Rotalipora brotzeni Zone, without the appearance of stratigraphically important species. (Fig. 3). Its planktonic assemblage is not suitable to solve stratigraphical problems, due to ecological problems.

MONOSTORI M. considers the Jásd Sandstone as a non-regressive series by ostracod studies. Depositional encivironment of this thick clastic series may be determined by further lithological, and palaeontological in-

vestigations. However, we know, that at the boundary of Upper Albian (s. str.) and Vraconian there was considerable deterioration of the climate, contemporaneously with strong tectonic activity.

Deposition of the platform-type Zirc Limestone underlying the Pénzeskút Marl was stopped by a brief emersion of the area, connected with glauconisation (Tabular Limestone Member). The following sedimentary cycle, (Pénzeskút Marl) began with strong glauconite deposition, with phosphoritic, condensed sediments, subtropical and temperate zone mega- and microfauna. The area subsided suddenly; coagulated chemical sediments were deposited in a sublittoral environment, changed to clastic sedimentation by the end of Early Cenomanian, with contemporaneous death of the fauna.

The most probable cause of the clastic sedimentation might have been the emersion of the source area, with increasing relief energy and rapid erosion with fluviatile transport. However, there is trace of decrease in salinity. This event did not affect the nannoflora. Among the contemporaneous effects of several factors the cooling of the climate might had the most significant role, with dominance of clastic sedimentation and impoverishment of the fauna.

Correlation of the Jásd – 42 stratotype profile, ecological conditions, and faunal relationships will be discussed in the second part of this paper.

REFERENCES

Birkelund, T. (1983): Setting the Stage and drawing the Line. – Cretaceous Stage Boundaries, p. 1 – 5, Coppenhagen, October 18 – 21.

Bodrogi, I. (1985): Die stratigraphische Untergliederung die Pénzeskuter Mergel – Formation mit Hilfe von Foraminiferen. – Beiträge zur Stratigraphie und Paläogeographie der Mittleren Kreide Zentral-Europas. Ergäbnisse der Mitteleuropäische Gruppe im Projekt 73/1/58 – Mid Cretaceous Event, Österreischische Akademie der Wisseschaften, Schriftenreiche der Erdwissenschaftlichen Komissionen, Band 7:97 – 113, Tafel 1 – 4, figs. 1 – 28, Wien, New York.

Császár, G., Haas, J. (1984): The Cretaceous in Hungary: A Review. – Acta Geologica Hungarica 27/3 – 4); pp. 417 – 428: figs. 7., Budapest.

Császár, G. (1985): Übersicht der Referenzprofile der Mittelkreide Ungarns. – Beiträge zur Stratigraphie und Paläogeographie der mittleren Kreide Zentral-Europas. Ergäbnis der Mitteleuropäischen Gruppe im Projekt 73/1/58 – Mid Cretaceous Events. Österreichische Akademie der Wissenschaften, Schriftenreihe der Erdwisseschaftliche Komissionen, Band 7:67 – 93, figs. 21., Wien, New York.

Horváth, A. (1985): Ammoniten-Stratigraphie der Pénzeskut Mergel-Formation. – Beiträge zur Stratigraphie und Paläogeographie der mittleren Kreide Zentral-Europas. Ergäbnis der Mitteleuropäischen Gruppe in Projekt 73/1/58 – Mid Cretaceous Events. Österreischische Akademie der Wissenschaften, Schriftenreiche der Erdwissenschaftliche Komissionen, Band 7:149 – 173, Tafel 1 – 4, figs, 35, Wien, New York.

Juignet, P. (1976): Presentation du Crétacé moyen dans L'Ouest de la France – Remarque sur les stratotypes du Cenomanien et du Turonien. Ann. Mus. Hist. Nat. Nice. 4/2/: 1 – 12, 4 figs., 15 tab., Nizza.

Juignet, P. (1978): Le Cenomanien du Maine: formation sedimentaires et faunes d'Ammonites du stratotype. – Geol. Mediterannéenne, 5/1/:87 – 100, figs. 1 – 11, Marseille.

Majzon, J. (1943): Előzetes jelentés a Zirc-Bakonycsernye közötti terület földtani viszonyáról. – MÁFI Évi Jelentés 1939 – 1940-ről, pp. 263 – 270, Budapest.

MAJZON L. (1966): Foraminifera vizsgálatok. – Akadémiai kiadó, p. 1 – 600, Budapest.

SCHOLZ, G. (1973): Geologische und stratigraphische Verhältnisse der mittelkretazischen Schichten des Bakony-Gebirges bei Nána und Pénzeskút. – Földtani Közlöny 103/2, 175 – 188, 2 figs., 2 pl., Budapest

SCHOLZ, G. (1979): Die Ammoniten des Vracons (Oberalb, dispar-Zone) des Bakony-Gebirges (Westungarn) und eine Revision der wichtigsten Vracon-Arten der westmediterranen Faunenprovinz. Teil 1 und 2. – Palaeontographica, Abt. A. 165/1 – 2, 1 – 80, 13 pl, 21 figs., 165/3 – 6, 81 – 136, 17 pl., 20 figs., Stuttgart.

SIDÓ, M. (1966): A bakonyi cenoman rétegek Foraminifera vizsgálata. Studium der cenomanischen Abteilungen des Bakony-gebirges anhand von Foraminiferen. MÁFI Évi Jelentés 1964-ről, pp. 223 – 243, 2 tabl., 4 ábra, Budapest.

SIDÓ, M. (1971): A bakonyi és vértesi rotalipórás-turriliteszes márgaösszlet Foraminifera-társulásai. – Földtani Közlöny, Bull. of the Hungarian Geol. Soc., 101/1/: 44 – 52.

SIGAL, J. (1977): Essai de zonation de Crétacé mediterrannéen á l'aide des foraminifers planctoniques. – Geol. Mediterannéenne, 4/2/:99 – 108, Marseille.

WONDERS, A. A. H. (1978): Phylogeny, classification and biostratigraphic distribution of keeled Rotaliporinae (I.) Proc. Kon. Nederl. Wet. B., 81/1/:113 – 124,5 figs., Amsterdam.