

**Zeitschrift:** Eclogae Geologicae Helvetiae  
**Herausgeber:** Schweizerische Geologische Gesellschaft  
**Band:** 75 (1982)  
**Heft:** 3

**Artikel:** A comparison of Aptian Foraminifera in Bulgaria and North West Germany  
**Autor:** Bartenstein, Helmut / Kovatcheva, Todorka  
**DOI:** <https://doi.org/10.5169/seals-165246>

### **Nutzungsbedingungen**

Die ETH-Bibliothek ist die Anbieterin der digitalisierten Zeitschriften. Sie besitzt keine Urheberrechte an den Zeitschriften und ist nicht verantwortlich für deren Inhalte. Die Rechte liegen in der Regel bei den Herausgebern beziehungsweise den externen Rechteinhabern. [Siehe Rechtliche Hinweise.](#)

### **Conditions d'utilisation**

L'ETH Library est le fournisseur des revues numérisées. Elle ne détient aucun droit d'auteur sur les revues et n'est pas responsable de leur contenu. En règle générale, les droits sont détenus par les éditeurs ou les détenteurs de droits externes. [Voir Informations légales.](#)

### **Terms of use**

The ETH Library is the provider of the digitised journals. It does not own any copyrights to the journals and is not responsible for their content. The rights usually lie with the publishers or the external rights holders. [See Legal notice.](#)

**Download PDF:** 14.03.2025

**ETH-Bibliothek Zürich, E-Periodica, <https://www.e-periodica.ch>**

Eclogae geol. Helv.	Vol. 75/3	Pages 621-667	5 figures in the text and 5 plates	Basle, November 1982
---------------------	-----------	---------------	---------------------------------------	----------------------

In memory of  
FRANZ BETTENSTAEDT

## A comparison of Aptian Foraminifera in Bulgaria and North West Germany

By HELMUT BARTENSTEIN<sup>1)</sup> and TODORKA KOVATCHEVA<sup>2)</sup>

### ABSTRACT

85 foraminiferal species, mostly benthonic forms, which are important as index Foraminifera for the comparison of the Aptian in Bulgaria and North West Germany, are described.

The paleontologic-systematic characteristics of the respective index Foraminifera are explained with the help of photographic plates, and their use in the correlation of the Aptian in Bulgaria and North West Germany are shown in three stratigraphic charts.

Four new species are erected, *Flabellamina bulgarica*, *Flabellamina urgonensis*, *Trochammina gerochi*, and *Quinqueloculina pseudominima*, distributed in the Tethyan Upper Barremian, Aptian and (Lower) Albian of Bulgaria.

### ZUSAMMENFASSUNG

Beschreibung von 85 Foraminiferenarten, meist benthonischen Formen, die als Leitforaminiferen für den Vergleich des Apts zwischen Bulgarien und Nordwestdeutschland von Bedeutung sind.

Die paläontologisch-systematischen Kennzeichen der betreffenden Leitforaminiferen werden anhand von Phototafeln erklärt; ihre Verwendung bei der Korrelation des Apts in Bulgarien und Nordwestdeutschland wird auf drei stratigraphischen Tabellen dargestellt.

Vier neue Arten werden aufgestellt, *Flabellamina bulgarica*, *Flabellamina urgonensis*, *Trochammina gerochi* und *Quinqueloculina pseudominima*, die im tethyalen Ober-Barrême, Apt und (Unter-)Alb von Bulgarien verbreitet sind.

### РЕЗЮМЕ

Описани са 85 фораминиферни вида, главно бентонни форми, които се използват при сравнението на апта от България и Северозападна Германия.

Палеонтоложко-систематичните особености на съответните ръководни фораминифери са илюстрирани с фототаблици, а взаимоотношенията между видовете установени при паралелизацията на аптския етаж от България и Северозападна Германия са показани в три стратиграфски таблици.

Описани са четири нови вида, *Flabellamina bulgarica*, *Flabellamina urgonensis*, *Trochammina gerochi* и *Quinqueloculina pseudominima*, които са разпространени в медитеранския тип горен барем, апт и (долен) алб от България.

<sup>1)</sup> Spoerckenstrasse 102, D-3100 Celle, Federal Republic of Germany.

<sup>2)</sup> Bulgarische Akademie der Wissenschaften, Geologisches Institut, Ul. «Akad. Georgi Bontchev» Bl. 2, Sofia 1113, People's Republic of Bulgaria.

## CONTENTS

Introduction .....	622
List of Foraminifera .....	623
Paleontologic-systematic descriptions .....	625
Stratigraphy and paleogeography .....	652
References .....	655

## Introduction

The micropaleontological description of the Lower Cretaceous in Bulgaria started in the sixties and was mainly connected with the name of two scientists: JOVCHEVA (1960, in cooperation with TRIFONOVA; 1962-1966) and KOVATCHEVA (1968-79): the latter's publications are concerned in particular with the Bulgarian Barremian pelagic and neritic facies, and with the Aptian neritic facies (Fig. 1). The Aptian substages in the northeastern part of the Moesian Platform are dealt with in a number of her publications, part 1, Bedoulian (1975), part 2, Gargasian (1976a) and part 3, Clansayesian (1977) (Fig. 2). The Aptian substages in the Fore-Balkan have sediments of a different type with Urgonian and para-Urgonian deposits. KOVATCHEVA's publications in this area commence with part 4, Bedoulian (1979a), and others are planned to follow at a later date.

The comparison of Lower Cretaceous Foraminifera in the Mediterranean and Boreal facies of Europe is very important in the recognition of migratory paths, and the extension of our regional knowledge helps to establish the validity of the determinations worldwide.

For the first time, BARTENSTEIN & KOVATCHEVA (1970) and BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA (1971), published a comparison of index Foraminifera from the Bulgarian Barremian in the Tethyan (Mediterranean) facies with the same index species from the North West German Barremian Boreal facies, using various worldwide data. In the present paper, we are extending these investigations to the index Foraminifera of the Aptian in Bulgaria and North West Germany (Fig. 3-5).

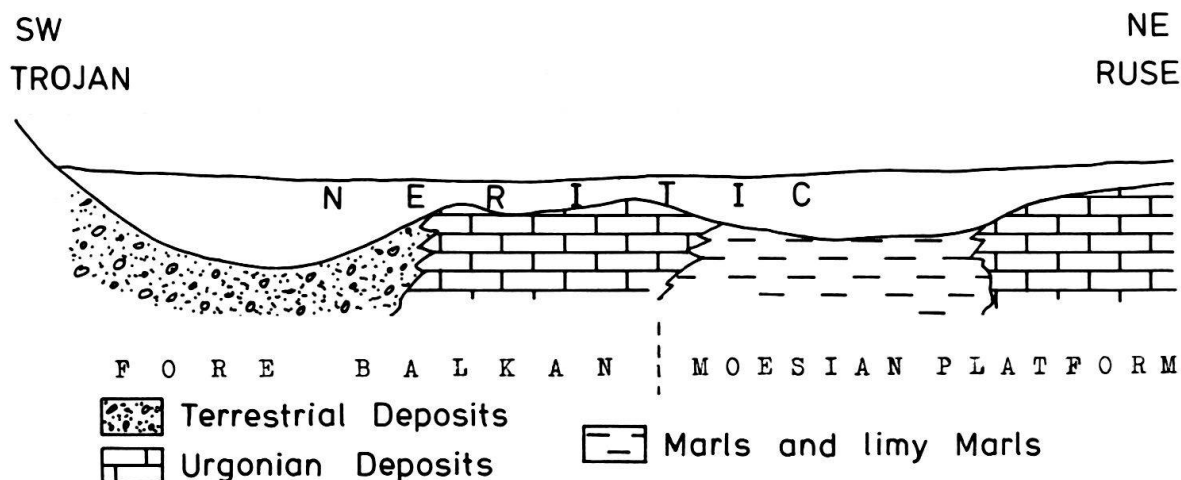


Fig. 1. Schematic SW-NE cross section of Bulgaria showing the neritic facies regions in the Aptian (Bedoulian, Gargasian and Clansayesian) with water depths above approximate 200 m.

BULGARIA Tethys	EUROPEAN STAGES	NORTH WEST GERMANY Boreal	
Diadochoceras nodosocostatum	CLANSAYESIAN	Hypacanthoplites jacobi Acanthohoplites nolani	UPPER
Cheloniceras subno- dosocostatum Aconeceras nisum	GARGASIAN	Parahoplites nutfieldiensis Epicheloniceras laticostatum Tropæum drewi	
Deshayesites deshayesi	BEDOULIAN	Dufrenoyia furcata Prodeshayesites tenuicostatus	LOWER

Fig. 2. Comparison of the Aptian in Bulgaria and North West Germany, belonging to different facies realms with differing index ammonites. Ammonite zonation in Bulgaria according to NIKOLOV (1965), in North West Germany to KEMPER (1976).

Our publication will be in memory of Franz Bettenstaedt, who joined us in our first publication on the Barremian in 1971.

The authors wish to express their gratitude to H.J. Oertli (Pau) and B.N. Fletcher (Harrogate) for their kind supply of material, micrographs and thoughts.

### List of Foraminifera

The list of foraminiferal species includes the important index forms, distributed in the Upper Barremian, Aptian and Lower Albian of Bulgaria (Tethyan facies realm), and also in North West Germany (north temperate = Boreal facies realm), with the following exception:

○ = Species exclusively distributed in Bulgaria or in other regions of the Tethyan facies realm, but never in North West Germany.

#### Arenaceous Foraminifera

##### Superfamily Astorhizidea

Genus *Ammodiscus* REUSS 1862  
○ *gaultinus* BERTHELIN 1880

Genus *Reophax* MONTFORT 1808  
*scorpiurus* MONTFORT 1808

##### Superfamily Lituolidea

Genus *Falsogaudryinella* BARTENSTEIN 1977  
*moesiana* (NEAGU 1965)

Genus *Flabellamina* CUSHMAN 1928  
○ *bulgarica* n.sp.  
○ *urgonensis* n.sp.<sup>3)</sup>

<sup>3)</sup> Urganian species of local importance: unlisted in Figure 3.



- Genus *Gaudryina* D'ORBIGNY 1839  
 ○ *borimensis* KOVATCHEVA 1969  
 ○ *praedivida* NEAGU 1975  
 ○ *reicheli* BARTENSTEIN, BETTENSTAEDT & BOLLI 1966
- Genus *Marssonella* CUSHMAN 1933  
*kummi* ZEDLER 1961  
 ○ *praeoxycona* (MOULLADE 1966)  
*subtrochus* BARTENSTEIN 1962
- Genus *Pseudocyclamina* YABE & HANZAWA 1926  
 ○ aff. *cylindrica* REDMOND 1964

- Genus *Textularia* DEFRANCE 1824  
*bettenstaedti* BARTENSTEIN & OERTLI 1977
- Genus *Triplasia* REUSS 1854  
*georgsdorfensis* (BARTENSTEIN & BRAND 1949)
- Genus *Tritaxia* REUSS 1860  
*pyramidata* REUSS 1863
- Genus *Trochammina* PARKER & JONES 1859  
 ○ *gerochi* n. sp.

#### Calcareous Foraminifera

##### Superfamily Buliminidea

- Genus *Pleurostomella* REUSS 1860  
*reussi* BERTHELIN 1880

##### Superfamily Miliolidea

- Genus *Ophthalmidium* ZWINGLI & KUEBLER 1870  
*gaultinum* (DAM 1950)
- Genus *Pseudonubeculina* BARTENSTEIN & BRAND 1949  
*nodulosa* (CHAPMAN 1891)
- Genus *Quinqueloculina* D'ORBIGNY 1826  
 ○ *pseudominima* n. sp.  
 ○ *scythica* NEAGU 1968

##### Superfamily Nodosariidea

- Genus *Citharina* D'ORBIGNY 1839  
*acuminata* (REUSS 1863)
- Genus *Dentalina* D'ORBIGNY 1826  
*communis* D'ORBIGNY 1826  
*debilis* (BERTHELIN 1880)  
*distincta* REUSS 1860  
*gracilis* D'ORBIGNY 1839  
*guttifera* D'ORBIGNY 1846  
*linearis* (ROEMER 1841)  
*nana* REUSS 1863
- Genus *Fronicularia* DEFRANCE 1826  
*filocincta* REUSS 1863  
*hastata* ROEMER 1842  
*inversa* REUSS 1845  
*loryi* (BERTHELIN 1880)  
*perovata* CHAPMAN 1894
- Genus *Lagena* WALKER & BOYS 1784  
 aff. *apiculata* (REUSS 1851)  
 aff. *hauteriviana* BARTENSTEIN & BRAND 1951
- Genus *Lenticulina* LAMARCK 1804 (with subgenera  
*Astacolus*, *Lenticulina*, *Marginulinopsis*,  
*Saracenaria* and *Vaginulinopsis*)
- Subgenus *Lenticulina* (*Astacolus*) MONTFORT 1808  
*calliopsis* (REUSS 1863)  
*crepidularis* (ROEMER 1842)  
*planiuscula* (REUSS 1863)  
*schloenbachi* (REUSS 1863)  
*scitula* (BERTHELIN 1880)
- Subgenus *Lenticulina* (*Lenticulina*) LAMARCK 1804  
*gaultina* (BERTHELIN 1880)  
*heiermanni* BETTENSTAEDT 1952  
*muensteri* (ROEMER 1839)  
*nodosa* (REUSS 1863)  
*ouachensis ouachensis* (SIGAL 1952)  
*pulchella* (REUSS 1863)  
 aff. *saxocretacea* BARTENSTEIN 1954  
*secans* (REUSS 1860)  
 aff. *sternalis* (BERTHELIN 1880)  
*subangulata* (REUSS 1863)  
*subgaultina* BARTENSTEIN 1962  
*turgidula* (REUSS 1863)
- Subgenus *Lenticulina* (*Marginulinopsis*) SILVESTRI 1904  
*djaffaensis* (SIGAL 1952)
- Subgenus *Lenticulina* (*Saracenaria*) DEFRANCE 1824  
*frankei* (DAM 1946)  
*spinosa* (EICHENBERG 1935)

- |  |  |
|--|--|
| Subgenus <i>Lenticulina</i> ( <i>Vaginulinopsis</i> ) SILVESTRI 1904<br><i>excentrica</i> (CORNUEL 1848) | Genus <i>Pyrulina</i> D'ORBIGNY 1839<br><i>infracretacea</i> BARTENSTEIN 1952                  |
| Genus <i>Nodosaria</i> LAMARCK 1812<br><i>obscura</i> REUSS 1845   | Genus <i>Ramulina</i> R. JONES 1875<br><i>aculeata</i> WRIGHT 1889                             |
| Genus <i>Palmula</i> LEA 1833<br>○ aff. <i>dentonensis</i> LOEBLICH & TAPPAN 1941                        | Genus <i>Tristix</i> MACFADYEN 1941<br><i>acutangula</i> (REUSS 1863)                          |
| Genus <i>Pseudonodosaria</i> BOOMGAART 1949<br><i>mutabilis</i> (REUSS 1863)                             | Genus <i>Vaginulina</i> D'ORBIGNY 1826<br><i>arguta</i> REUSS 1860<br><i>kochi</i> ROEMER 1841 |

## Superfamily Rotaliidea

- |   |   |
|---|---|
| Genus <i>Conorotalites</i> KAEVER 1958<br><i>aptiensis</i> (BETTENSTAEDT 1952)<br><i>intercedens</i> (BETTENSTAEDT 1952)  | Genus <i>Hedbergella</i> BROENNIMANN & BROWN 1958<br><i>infracretacea</i> (GLAESSNER 1937)<br><i>planispira</i> (TAPPAN 1940)<br>○ <i>tardita</i> (ANTONOVA 1964) |
| Genus <i>Epistomina</i> TERQUEM 1883<br><i>caracolla</i> (ROEMER 1841)<br><i>chapmani</i> DAM 1948<br>○ <i>colomi</i> DUBOURDIEU & SIGAL 1949<br><i>cretosa</i> DAM 1947<br><i>reticulata</i> (REUSS 1863)<br><i>spinulifera</i> (REUSS 1863) | Genus <i>Lamarckina</i> BERTHELIN 1881<br><i>lamplughi</i> (SHERLOCK 1914)  |
| Genus <i>Gavelinella</i> BROTZEN 1942<br><i>barremiana</i> BETTENSTAEDT 1952<br><i>intermedia</i> (BERTHELIN 1880)  | Genus <i>Planomalina</i> LOEBLICH & TAPPAN 1946<br><i>caseyi</i> BOLLI, LOEBLICH & TAPPAN 1957  |
| Genus <i>Globigerinelloides</i> CUSHMAN & DAM 1948<br>○ <i>algerianus</i> CUSHMAN & DAM 1948  | Genus <i>Ticinella</i> REICHEL 1949<br>○ <i>roberti</i> (GANDOLFI 1942)   |
|   | Genus <i>Valvulineria</i> CUSHMAN 1926<br><i>loetterlei</i> (TAPPAN 1940)   |

## Superfamily Spirillinidea

- |   |  |
|---|--|
| Genus <i>Patellina</i> WILLIAMSON 1858<br><i>subcretacea</i> CUSHMAN & ALEXANDER 1930 | Genus <i>Spirillina</i> EHRENBERG 1843<br><i>minima</i> SCHACKO 1892 |
|---|--|

**Paleontologic-systematic descriptions**

In cases where the taxonomic criteria used for the specific determination of an index form are different between the two authors, any species name, used in Bulgarian publications by KOVATCHEVA, is given priority over the others. We believe that this decision is important for the future use of this paper and for facilitating any correlations using East European publications, and in particular those from Rumania and USSR.

Frequency symbols are used very rarely, because all frequency comparisons between Tethyan and Temperate occurrences are practically impossible and because of local development of species groups. The deviation from any norm corresponds to particular local, random events.

Symbols in the synonymy lists are used according to RUDOLF RICHTER (1948, p. 53-55): \* = designation of a new species; v = vidimus; · = the specimen belongs to the cited species.

Scanning electron micrographs were taken in the Scanning Laboratory of the Elf-Aquitaine Research Center at Pau, France.

The sequence of genera and species follows the alphabetical order in the list of Foraminifera. The same applies to Figures 3–5 which are also arranged in alphabetical order.

The figured specimens are deposited at the Museum of Natural History, Basel (NMB).

### *Index Foraminifera in Figure 3*

#### *Ammodiscus gaultinus* BERTHELIN 1880

Pl. 1, Fig. 1–2

v. 1979a *Ammodiscus gaultinus* BERTHELIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 2, Fig. 8.

	Barremian	Lower Aptian	Middle Aptian	Upper Aptian	Albian
	Upper	Bedoulian	Gargasian	Clansayesian	Lower
<i>Ammodiscus gaultinus</i>	-----				
<i>Reophax scorpiurus</i>	-----				
<i>Falsogaudryinella moesiana</i>					
<i>Flabellamina bulgarica</i> n.sp.	.....				
<i>Gaudryina borimensis</i>	.....				
<i>Gaudryina praedivdens</i>	.....				
<i>Gaudryina reicheli</i>	.....				
<i>Marssonella kummi</i>	.....				
<i>Marssonella praeoxycona</i>	.....				
<i>Marssonella subtrochus</i>	-----				
<i>Pseudocyclammia</i> aff. <i>cylindrica</i>					
<i>Textularia bettenstaedti</i>	-----				
<i>Triplasia georgsdorfensis</i>					
<i>Tritaxia pyramidata</i>					
<i>Trochammina gerochi</i> n.sp.	.....				
<i>Pleurostomella reussi</i>					.....
<i>Ophthalmidium gaultinum</i>		.....			
<i>Pseudonubeculina nodulosa</i>	-----				
<i>Quinqueloculina pseudominima</i> n.sp.	.....				
<i>Quinqueloculina scythica</i>		.....			
<i>Citharina acuminata</i>	-----				
<i>Dentalina communis</i>	-----				
<i>Dentalina debilis</i>	-----				
<i>Dentalina distincta</i>	-----				
<i>Dentalina gracilis</i>	-----				
<i>Dentalina guttifera</i>	.....				
<i>Dentalina linearis</i>	-----				
<i>Dentalina nana</i>	-----				
<i>Frondicularia filocincta</i>	-----				

Fig. 3. Stratigraphic distribution of important index Foraminifera in the Upper Barremian, Aptian and Lower Albian of North West Germany and Bulgaria.

----- North West Germany, Boreal facies realm.

..... Bulgaria, Tethyan facies realm.

*Occurrence.* – In Bulgaria throughout the Lower Cretaceous, the same as in North West Germany and worldwide in the Temperate and Tethyan facies realms, rare; a species without any particular stratigraphic value.

*Reophax scorpiurus* MONTFORT 1808

Pl. 1, Fig. 3–4

v.1979a *Reophax scorpiurus* MONTFORT, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 13, Pl. 1, Fig. 9.

*Occurrence.* – Bulgaria: Barremian and Bedoulian, but in North West Germany and North West Europe throughout the Lower Cretaceous and persisting to present oceans; a species distributed worldwide without any particular stratigraphic value.

*Falsogaudryinella moesiana* (NEAGU 1965)

Pl. 1, Fig. 7–10; Pl. 5, Fig. 12–15

v.1979 *Falsogaudryinella moesiana*, BARTENSTEIN, Newsl. Stratigr. 7/3, p. 151, Table 2.

	Barremian	Lower Aptian	Middle Aptian	Upper Aptian	Albian
	Upper	Bedoulian	Gargasian	Clansayesian	Lower
<i>Frondicularia hastata</i>					
<i>Frondicularia inversa</i>					
<i>Frondicularia loryi</i>					
<i>Frondicularia perovata</i>					
<i>Lagena</i> aff. <i>apiculata</i>					
<i>Lagena</i> aff. <i>hauteriviana</i>					
<i>Lenticulina</i> ( <i>A.</i> ) <i>calliopsis</i>					
<i>Lenticulina</i> ( <i>A.</i> ) <i>crepidularis</i>					
<i>Lenticulina</i> ( <i>A.</i> ) <i>planiuscula</i>					
<i>Lenticulina</i> ( <i>A.</i> ) <i>schloenbachi</i>					
<i>Lenticulina</i> ( <i>A.</i> ) <i>scitula</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>gaultina</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>heiermanni</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>muensteri</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>nodosa</i>					
<i>L. (L.) ouachensis ouachensis</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>pulchella</i>					
<i>Lent. (L.)</i> aff. <i>saxocretacea</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>secans</i>					
<i>Lent. (L.)</i> aff. <i>sternalis</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>subangulata</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>subgaultina</i>					
<i>Lenticulina</i> ( <i>L.</i> ) <i>turgidula</i>					
<i>Lenticulina</i> ( <i>M.</i> ) <i>djaffaensis</i>					
<i>Lenticulina</i> ( <i>S.</i> ) <i>frankei</i>					
<i>Lenticulina</i> ( <i>S.</i> ) <i>spinosa</i>					
<i>Lenticulina</i> ( <i>V.</i> ) <i>excentrica</i>					
<i>Nodosaria obscura</i>					

Fig. 4. Stratigraphic distribution of important index Foraminifera in the Upper Barremian, Aptian and Lower Albian of North West Germany and Bulgaria.

*Occurrence.* – Bulgaria: Clansayesian and Albian, collected at Kozar Belene about 70 km SW of the Rumanian type locality Giurgiu and about 50 km SE of Putiniu in the Albian.

Occurrence in BARTENSTEIN (1981, p.317): “Throughout Europe (and also Asia Minor?) in the Boreal and Tethyan facies realms of the higher Lower Cretaceous, common in the Albian, but beginning in the Aptian and persisting into the Cenomanian.

According to Sliter 1976 it also occurs in the Middle Albian of the southern Temperate realms east of the Falkland Plateau.”

For information on the first author’s opinion about the distribution, distinction and validity of the species *tealbyensis-alta-moesiana*, see BARTENSTEIN (1977, p.398, and 1981, p.316–317).

Occurrence of the genus *Flabellamina* CUSHMAN 1928  
in the Lower Cretaceous

The occurrences of *Flabellamina* specimens in the worldwide Lower Cretaceous represent distinctly modified species:

	Barremian	Lower Aptian	Middle Aptian	Upper Aptian	Albian
	Upper	Bedoulian	Gargasian	Clansayesian	Lower
<i>Palmula</i> aff. <i>dentonensis</i>					
<i>Pseudonodosaria mutabilis</i>					
<i>Pyrulina infracretacea</i>					
<i>Ramulina aculeata</i>					
<i>Tristix acutangula</i>					
<i>Vaginulina arguta</i>					
<i>Vaginulina kochi</i>					
<i>Conorotalites aptiensis</i>					
<i>Conorotalites intercedens</i>					
<i>Epistomina caracolla</i>					
<i>Epistomina chapmani</i>					
<i>Epistomina colomi</i>					
<i>Epistomina cretosa</i>					
<i>Epistomina reticulata</i>					
<i>Epistomina spinulifera</i>					
<i>Gavelinella barremiana</i>					
<i>Gavelinella intermedia</i>					
<i>Globigerinelloides algerianus</i>					
<i>Hedbergella infracretacea</i>					
<i>Hedbergella planispira</i>					
<i>Hedbergella tardita</i>					
<i>Lamarckina lamplughi</i>					
<i>Planomalina caseyi</i>					
<i>Ticinella roberti</i>					
<i>Valvulineria loetterlei</i>					
<i>Patellina subcretacea</i>					
<i>Spirillina minima</i>					

Fig. 5. Stratigraphic distribution of important index Foraminifera in the Upper Barremian, Aptian and Lower Albian of North West Germany and Bulgaria.

BARTENSTEIN & BRAND (1951, p.269) with *Flabellamina stadthageni* from the Valanginian and Hauterivian in North West Germany;

FRIZZELL (1954, p.63) with various *Flabellamina* species from the American Lower and Upper Cretaceous;

DIENI & MASSARI (1966, p.95, 97, Pl.2, Fig.2) (tipo *Flabellamina*) with various "generations" of *Flabellamina* growth in the Jurassic and Lower Cretaceous, may be quoted as representatives. Therefore the American and Bulgarian forms of *Flabellamina rugosa* and *Flabellamina alexanderi*, respectively, do not coincide very well: we believe that the Bulgarian specimens represent local facies forms, only distributed in the Tethyan facies of East Europe. For these forms, we denominate two new species, *Flabellamina bulgarica* and *Flabellamina urgonensis*.

*Flabellamina bulgarica* n. sp.

Pl. 1, Fig. 11-12

v.1975 *Flabellamina rugosa* ALEXANDER & SMITH, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p.38, Pl. 1, Fig. 6.

*Derivation of name.* – From Bulgaria as its original country.

*Holotype.* – Plate 1, Figure 11. Length 0.95 mm, width 0.55 mm. NMB C 35306.

*Paratypes.* – Plate 1, Figure 12. Length 1.03 mm, width 0.48 mm. NMB C 35307. Specimen in KOVATCHEVA (1975, Pl. 1, Fig. 6). Length 1.15 mm, width 0.65 mm.

*Type locality.* – Section near village Asenovo, district Veliko Tarnovo.

*Type horizon.* – Bedoulian (= Lower Aptian).

*Description.* – Test free, arenaceous, long but relatively narrow, lamelliform, compressed, with small initial spire and following five or more chambers of the straight portion of the test. Surface incrustated by sandy and argillaceous particles, aperture terminal, at the end of a distinct neck.

*Remarks.* – No relationship to one of the other (Lower) Cretaceous *Flabellamina* species is known.

*Occurrence.* – Rare but characteristic in the Upper Barremian and Bedoulian of Bulgaria. Until now, this new species has only been found in the Tethyan Lower Cretaceous of Bulgaria, perhaps as a local facies form.

*Flabellamina urgonensis* n. sp.

Pl. 1, Fig. 26-27

v.1979a *Flabellamina alexanderi* CUSHMAN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.13, Pl.2, Fig. 1.

1979b *Flabellamina alexanderi*, KOVATCHEVA, Mém. spéc. Géobios 3, p. 189, Fig. 3.

*Derivation of name.* – From Urganian as the facies type of its habitat.

*Holotype.* – Plate 1, Figure 26. Length 1.7 mm, width 0.65 mm. NMB C 35320.

*Paratype.* – Plate 1, Figure 27. Length 0.8 mm. NMB C 35321.

*Type locality.* – Koevci (Veliko Tarnovo).

*Type horizon.* – Bedoulian, Urganian facies type.

*Description.* – Test free, large, roughly ovate in outline, compressed, periphery rounded but irregular in outline, early portion coiled, later uniserial with five or more chambers; sutures generally indistinct; wall coarsely arenaceous with large grains; aperture terminal, elliptical, indistinct.

*Remarks.* – No relationship to one of the other (Lower) Cretaceous *Flabellamina* species is known.

*Occurrence.* – Rare but characteristic in the Bedoulian to Gargasian of the Urganian facies type (Fig. 1).

*Gaudryina borimensis* KOVATCHEVA 1969

Pl. 1, Fig. 13

v.1979a *Gaudryina borimensis* KOVATCHEVA, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.13, Pl.1, Fig.3.

*Occurrence.* – Up to now this species has been found only in Bulgaria and Rumania, Tethyan facies realm, from Hauterivian to Bedoulian.

*Gaudryina praedivdens* NEAGU 1975

Pl. 1, Fig. 14–15

v.1971 *Gaudryina* cf. *divdens* GRABERT, BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA, N. Jb. Geol. Paläont. [Abh.] 139/2, p. 132, Abb. 1, Fig. 8; Abb. 4, Fig. 86–88.

\*1975 *Gaudryina praedivdens* NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p. 34, Pl. 14, Fig. 1–8, 29–35.

v.1979a *Gaudryina* cf. *divdens* GRABERT, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 13, Pl. 1, Fig. 5.

*Occurrence.* – So far this species has only been found in the Tethyan facies realm of Bulgaria, Upper Barremian and Bedoulian, and in Rumania, Upper Hauterivian to Lower Aptian (= Bedoulian).

The specific growth of the tests was described in detail by BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA (1971) with the result, that this locally developed Mediterranean variety may be a subspecies of *G. divdens* rather than a true species: in this particular case we designate such specimens as *Gaudryina divdens praedivdens* NEAGU 1975. We regret that NEAGU (1975) had no opportunity to compare his Rumanian material with the specifically same Bulgarian material, first described in 1971 by BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA.

*Gaudryina reicheli* BARTENSTEIN, BETTENSTAEDT & BOLLI 1966

Pl. 1, Fig. 16

v.1973 *Gaudryina reicheli* BARTENSTEIN, BETTENSTAEDT & BOLLI, BARTENSTEIN & BOLLI, Eclogae geol. Helv. 66/2, p. 396, Pl. 2, Fig. 36–51.

*Occurrence.* – First discovered in the Upper Aptian to Lower Albian of Trinidad, W.I., and secondly in the Upper Aptian (= Clansayesian) of Bulgaria, probably a good index Foraminifer in the Tethyan facies. According to BARTENSTEIN, BETTENSTAEDT & BOLLI (1966, 1973), the variability of *G. reicheli* is relatively large and



ranges from very slim tests up to very big and tall tests (e.g. our material in Bulgaria).

*Gaudryinella caucasica* SCHOKHINA 1960, first cited in Bulgaria by KOVATCHEVA (1979a) and described by GORBACHIK & SCHOKHINA in DRUSCHTSCHITZ & KUDRJAYTSHEV (1960, p.83, Pl.2, Fig.8), has a shape similar to *G.reicheli*, but without material from the type horizon and type locality, we cannot decide whether *G.reicheli* is a junior synonym of *G. caucasica*.

#### *Marssonella kummi* ZEDLER 1961

v.1971 *Marssonella kummi* ZEDLER, BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA, N. Jb. Geol. Paläont. [Abh.] 139/2, p.130, Abb.1, Fig.2.

1979a *Marssonella kummi* ZEDLER, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.13, Pl.1, Fig.6.

*Occurrence.* – In Bulgaria from Hauterivian to Barremian (and Bedoulian? according to KOVATCHEVA), in Rumania from Valanginian to Upper Barremian; worldwide in the Temperate and Tethyan facies realms from Upper Jurassic-Tithonian to Barremian.

According to BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA (1971, p.132), Bulgarian specimens of *Marssonella kummi* in the Aptian (and Albian?) belong to *Marssonella praeoxycona* (MOULLADE 1966) or to *Marssonella subtrochus* BARTENSTEIN 1962, which has developed from *Marssonella kummi*.

#### *Marssonella praeoxycona* (MOULLADE 1966)

Pl. 1, Fig.20-21; Pl. 5, Fig. 16

v.1979 *Dorothia (Marssonella) praeoxycona* (MOULLADE), BARTENSTEIN, Newsl. Stratigr. 7/3, p.148, Table 2.

*Occurrence.* – Bulgaria: Barremian?, Bedoulian to Gargasian; Rumania: Barremian; Trinidad: Barremian to Lower Albian; a useful worldwide index Foraminifer, distributed exclusively in the Tethyan facies from Barremian to Lower Albian.

Concerning the generic decision, *Marssonella* or *Dorothia*, see the corresponding remarks in BARTENSTEIN, BETTENSTAEDT & KOVATCHEVA (1971, p. 131).

#### *Marssonella subtrochus* BARTENSTEIN 1962

Pl. 1, Fig.22-23; Pl. 5, Fig. 17-18

v.1979a *Marssonella subtrochus* BARTENSTEIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.14, Pl.1, Fig.16.

*Occurrence.* – In Bulgaria from Barremian to Clansayesian; a worldwide index Foraminifer distributed in the Temperate and Tethyan facies realms from Middle Barremian to Albian and persisting to the Cenomanian.

#### *Pseudocyclammina* aff. *cylindrica* REDMOND 1964

Pl. 1, Fig.5-6



- 1975 *Pseudocyclammina cylindrica* REDMOND, NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p. 26, Pl. 6, Fig. 25–27; Pl. 110, Fig. 16–17.
- v. 1979 *Ammobaculites subcretaceus* CUSHMAN & ALEXANDER, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 13, Pl. 1, Fig. 2 (non *Ammobaculites subcretaceus*).

*Occurrence.* – Bulgaria: Aptian and Albian; Rumania: Upper Valanginian to Lower Aptian; also distributed in North Africa; an index Foraminifer exclusively distributed in the Tethyan facies realm of the northern hemisphere.

Further comparative material should be helpful in clearing up the relationship between *Pseudocyclammina* and *Everticyclammina* REDMOND 1964 by NEAGU 1975 and the true distribution and specific determination of these forms in Bulgaria and Rumania.

### *Textularia bettenstaedti* BARTENSTEIN & OERTLI 1977

Pl. 1, Fig. 24–25

- 1960 *Textularia foeda* REUSS, JOVCHEVA & TRIFONOVA, Ann. Dir. gén. Rech. géol. (Sofia) 11, p. 179, Pl. 4, Fig. 5–9 [pars].
- v. 1981 *Textularia bettenstaedti* BARTENSTEIN & OERTLI, BARTENSTEIN, N. Jb. Geol. Paläont. [Abh.] 161/3, p. 310.

*Occurrence.* – Bulgaria: Tethyan facies, throughout the Lower Cretaceous; North West Germany: Boreal facies, very rare in the Upper Valanginian to Middle Barremian and in the higher Middle Albian; rare in the Lower Aptian and lowermost Middle Albian; common in the Upper Aptian and Lower Albian. North Atlantic “Vigo Seamount” and “Gorringe Bank”: higher Barremian in Tethyan facies. The species is also distributed in the Upper Aptian to Lower Albian of the Bavarian Alps and of England.

*Textularia bettenstaedti* is an excellent index Foraminifer for the higher Lower Cretaceous (Barremian locally, Aptian to Albian) in the Boreal and Tethyan facies realm, which is a time-equivalent to *Lenticulina* (*S.*) *spinosa* (EICHENBERG 1935), *Gaudryina dividens* GRABERT 1959, *Epistomina reticulata* (REUSS 1863) and *E. spinulifera polypoides* (EICHENBERG 1933) or *E. colomi* DUBOURDIEU & SIGAL 1949 (see BARTENSTEIN 1977, p. 33–34); and it may also be distributed worldwide like these index species.

We cannot confirm the occurrences of *T. bettenstaedti* in Bulgaria below the Barremian, as cited by JOVCHEVA & TRIFONOVA (1960). Various investigated tests belong to other species and/or genera. A systematic and stratigraphic reinterpretation would be useful.

### *Triplasia georgsdorfensis* (BARTENSTEIN & BRAND 1949)

Pl. 1, Fig. 17

- v. 1979a *Triplasia georgsdorfensis* (BARTENSTEIN & BRAND), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 13, Pl. 1, Fig. 1.

*Occurrence.* – In Bulgaria distributed from Lower Barremian to Bedoulian as a good index Foraminifer; worldwide in the Temperate and Tethyan facies realms from Upper Valanginian to Lower Aptian (= Bedoulian).

*Tritaxia pyramidata* REUSS 1863

Pl. 1, Fig. 18-19

v-1979a *Tritaxia pyramidata* REUSS, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 4, Fig. 10.

*Occurrence.* - In Bulgaria and Rumania throughout the Lower Cretaceous, common, distributed in the Tethys from Valanginian to Albian. North West Germany and North West Europe including the Boreal facies realm from Upper Aptian into the Upper Cretaceous, common to rare, only locally frequent.

According to FLETCHER (1973, p. 165, Fig. 2-3), *T. pyramidata* occurs also in the Hauterivian and Barremian at Speeton, Yorkshire. According to FRIEG (1980, p. 234) *T. pyramidata* belongs to *T. tricarinella* REUSS 1843.

*Trochammina gerochi* n. sp.

Pl. 1, Fig. 28-31

1966 *Recurvoides* aff. *contortus* EARLAND, GEROCH, Ann. Soc. géol. Pol. 36/4, p. 443, Fig. 10 (9), 11 (2-4).1972 *Recurvoides* aff. *contortus* EARLAND, NEAGU, Rev. españ. Micropaleont. 4/2, p. 193, Pl. 2, Fig. 9-11; Pl. 4, Fig. 10-11.v-1975 *Trochammina globigeriniformis* (PARKER & JONES), KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 39, Pl. 1, Fig. 4-5 [non *T. globigeriniformis*].v-1976a *Trochammina globigeriniformis* (PARKER & JONES), KOVATCHEVA, Palaeont. Stratigr. Lithol. 4, p. 29, Table 1 [non *T. globigeriniformis*].

*Derivation of name.* - The species is named in honour of Stanislaw Geroch, who first described the new material in the Lower Cretaceous of Poland.

*Holotype.* - Plate 1, Figure 28. Ventral side, diameter 0.65 mm. NMB C 35322.

*Paratype.* - Plate 1, Figure 29. Dorsal side, diameter 0.7 mm. NMB C 35323.

*Type locality.* - Section near village Bojka, district Ruse.

*Type horizon.* - Bedoulian (= Lower Aptian).

*Further material (paratypes).* - Two specimens, section near village Radanovo, district Veliko Tarnovo; age Bedoulian. Plate 1, Figure 30, ventral side, diameter 0.6 mm. Plate 1, Figure 31, dorsal side, diameter 0.57 mm.

*Description.* - Test free, coarsely arenaceous, agglutinated; trochoid, convex dorsally, ventrally slightly concave, periphery rounded; sutures indistinct, at the inner margin of the central side of the last formed chamber.

*Remarks.* - The new species shows a great variability in the arrangement and number of chambers. Therefore we cannot give a final conclusion of the true generic allocation and the conformity between the cited species from Poland (6-8 chambers in the last whorl, diameter 0.32-0.50 mm), Rumania (5-9 chambers, diameter 0.43-0.72 mm) and Bulgaria (4 chambers, diameter 0.45-0.7 mm).

There exists no relationship with the recent forms of *Recurvoides contortus* EARLAND or to other *Recurvoides* species.

*Occurrence.* - Bulgaria: Upper Hauterivian to Gargasian; Rumania: Aptian; Polish External Carpathians: Barremian to Albian; a predominantly Mediterranean index Foraminifer of local importance in the (Upper) Barremian to Albian.

*Pleurostomella reussi* BERTHELIN 1880

Pl. 1, Fig. 32

v.1979b *Pleurostomella reussi*, KOVATCHEVA, Mém. spéc. Géobios 3, Fig. 3.

*Occurrence.* - Bulgaria: Upper Clansayesian to Albian; worldwide in the Temperate and Tethyan facies realms from Lower Albian to the Upper Cretaceous. According to BARTENSTEIN (1954) and other authors, *P. reussi* is the microspheric stage of and belongs in the synonymy to *P. obtusa*.

Bulgaria shows a distinctly earlier appearance of the species and species group, respectively, than abroad. Herewith, it resembles LUTERBACHER's observation (1975, p. 705, Pl. 3, Fig. 3-4) with *P. reussi* from Aptian to Cenomanian in the North West Pacific.

*Ophthalmidium gaultinum* (DAM 1950)

Pl. 1, Fig. 33-34

v.1979a *Ophthalmidium gaultinum* (TEN DAM), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 2, Fig. 23.

*Occurrence.* - Bulgaria: Aptian, Bedoulian to Clansayesian; Rumania: Hauterivian; England and Netherlands: Albian; no observations in North West Germany. According to hitherto existing publications, the species seems to be distributed from Valanginian to Albian, but always very rare.

We see no necessity for the distinction of two genera, *Ophthalmidium* ZWINGLI & KUEBLER 1870, and *Spirophthalmidium* CUSHMAN 1927, both ranging from Jurassic to Recent. We therefore prefer the first name *Ophthalmidium*.

*Pseudonubeculina nodulosa* (CHAPMAN 1891)

Pl. 1, Fig. 35-36

v.1979a *Nodobacularia nodulosa* (CHAPMAN), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 18, Pl. 2, Fig. 24.

*Occurrence.* - Bulgaria: Barremian and Aptian, rare; England: Upper Valanginian to Barremian and Middle to Upper Albian; Netherlands: Hauterivian and Albian; North West Germany: according to BARTENSTEIN & BRAND (1949, p. 670) "in the oldest and youngest parts of the Lower Cretaceous, in the Valendis, Hauterivian and Gault. We suppose they occur throughout the Lower Cretaceous, but the fragile tests are mostly destroyed in disintegrating the rock."

*Pseudonubeculina nodulosa* of ASCOLI (1976, p. 722, Fig. 30; Pl. 7, Fig. 6) is another species of arenaceous Foraminifera but not a *Pseudonubeculina*, a genus of the family Miliolidae D'ORBIGNY (personal examination of the original material in the Atlantic Geoscience Centre in Dartmouth). The distribution from Berriasian to Albian in East Canada for the illustrated specimen is therefore erroneous.

Occurrence of the genus *Quinqueloculina* D'ORBIGNY 1826  
in the Jurassic and Lower Cretaceous

There exists a distinct uncertainty in determining Jurassic and Lower Cretaceous forms of the genus *Quinqueloculina*. According to BARTENSTEIN (1965, p. 350-351), various species of the genera *Quinqueloculina*, *Miliolina* and *Sigmoilina*

in the Lower Cretaceous of North West Europe and North West Germany belong to the genus *Pseudosigmoilina* BARTENSTEIN 1965. The sole description of a *Quinqueloculina*-like form in the North West German Upper Hauterivian and Barremian was *Pseudosigmoilina subtilis* (MICHAEL 1967, p.32, Pl.10, Fig.18) with citation of *Quinqueloculina* D6 HECHT.

According to Bartenstein (1965, p.355), the facies conditions in the North West German Valanginian to Aptian were too unfavourable for the occurrence of *Quinqueloculina*- and *Pseudosigmoilina*-like forms which prefer higher temperatures of the sea and reef-like deposits with organic detrital sediments, known e.g. in Switzerland, in Bulgaria and Rumania.

According to B. N. Fletcher, Harrogate (personal communication), *Quinqueloculina* species occur also in the Barremian of Speeton, Yorkshire, with lengths of 0.36–0.54 mm, and widths of 0.216–0.306 mm.

*Quinqueloculina pseudominima* n. sp.

Pl. 1, Fig. 37–39

- 1962 *Quinqueloculina minima* TAPPAN, JOVCHEVA, Rev. Bulgar. geol. Soc. 23/1, p.52, Pl. 2, Fig. 5–6.  
 v.1979a *Quinqueloculina minima* TAPPAN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.14, Pl. 2, Fig. 14.  
 1975 *Quinqueloculina minima* TAPPAN, NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p.53, pl. 109, Fig. 23–25.

*Derivation of name.* – The name points to the possibility of a relationship with the American species *Quinqueloculina minima* TAPPAN 1943, which is unknown until now outside of America.

*Holotype.* – Plate 1, Figure 37. Length 0.4 mm, width 0.28 mm. NMB C 35331.

*Paratypes.* – Plate 1, Figure 38, Length 0.42 mm, width 0.28 mm. NMB C 35332.  
 – Plate 1, Figure 39. Width 0.51 mm. NMB C 35333.

*Type locality.* – Section near village Koevci, district Veliko Tarnovo.

*Type horizon.* – Bedoulian (= Lower Aptian).

*Description.* – Test free, ovate in outline, periphery rounded or slightly angular, chambers arranged in a quinqueloculine pattern; sutures distinct, depressed; wall calcareous, imperforate, surface smooth; aperture simple, at the end of the chamber, no tooth visible.

*Remarks.* – We cannot find any conformity between the Bulgarian specimens with lengths from 0.40 to 0.42 mm, and the American specimens of *Qu. minima* with length of 0.182 mm, breadth 0.12 mm, thickness 0.10 mm (TAPPAN 1943, p.491); and lengths from 0.16 to 0.23 mm (LOEBLICH & TAPPAN 1949, p.255). According to FRIZZELL (1954, p.76–77), the Texan Lower and Upper Cretaceous contain a lot of *Quinqueloculina* species, but because of their poor preservation are sometimes difficult to distinguish. Unknown until now in North West Europe and North West Germany.

It would be important to check the validity and relationship of these American specimens to the genus *Pseudosigmoilina* and to the East European *Quinqueloculina* species in the Tethyan facies, also to *Quinqueloculina scythica* NEAGU 1968.

Our Plate 1, Figure 39, shows a relatively thick test with irregular outline and width of 0.51 mm: may be, that it signifies a typical change of generation, but not a phylogenetic sequence.

*Occurrence.* – Bulgaria: Upper Barremian to Albian; Rumania: Lower Barremian to Aptian; a predominantly Mediterranean index Foraminifer of local importance in the Barremian to Albian of East Europe.

*Quinqueloculina scythica* NEAGU 1968

Pl. 1, Fig. 40–42

v-1979a *Quinqueloculina scythica* NEAGU, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 18, Pl. 2, Fig. 12–13.

*Occurrence.* – Up to now this species has been found in the Barremian of Rumania and in the Aptian of Bulgaria; unknown in North West Germany and North West Europe.

The first author (HB) cannot find any conformity between Plate 1, Figures 40–41, specimens from Bulgaria, and Plate 1, Figure 42, specimen from Rumania (NEAGU's original material). The distinction between relatively tall (Fig. 42, length 0.62 mm) and more slender tests (Fig. 40–41, length 0.4–0.42 mm) may signify a typical change of generation, but not a phylogenetic sequence.

*Citharina acuminata* (REUSS 1863)

Pl. 2, Fig. 1–2

v-1979 *Citharina acuminata* (REUSS), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 146, Table 1.

*Occurrence.* – Bulgaria: Upper Barremian to Gargasian; North West Germany: Uppermost Hauterivian to Lowermost Albian; a worldwide distributed rare, but good index Foraminifer, occurring “in the northern Temperate areas from late Upper Hauterivian to early Lower Albian, and in the Tethys from middle Middle Barremian to middle Lower Albian” (BARTENSTEIN & BOLLI 1977, p. 554).

*Dentalina communis* D'ORBIGNY 1826

Pl. 2, Fig. 4–5

v-1979a *Dentalina communis* D'ORBIGNY, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 1.

*Occurrence.* – Bulgaria: Upper Hauterivian to Bedoulian; North West Germany and worldwide: throughout the Cretaceous and persisting to the Tertiary, common to mostly rare. The species has no particular stratigraphic value.

*Dentalina debilis* (BERTHELIN 1880)

Pl. 2, Fig. 3

v-1979a *Dentalina debilis* (BERTHELIN), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 19, Pl. 3, Fig. 12.

*Occurrence.* – Bulgaria: Barremian and Aptian (Bedoulian to Clansayesian) rare; North West Germany: throughout the Lower Cretaceous also rare; a species

distributed in the Lower Cretaceous worldwide, common but rare, without any particular stratigraphic value.

*Dentalina distincta* REUSS 1860

Pl. 2, Fig. 6-7

1979 *Dentalina distincta* REUSS, SPROVIERI, Lav. Ist. Geol. Univ. (Palermo) 14, p. 4, 6, Pl. 1, Fig. 35.

*Occurrence.* – Bulgaria: Upper Barremian and Bedoulian rare; North West Germany: highest Lower Barremian to Middle Albian rare, but found most frequently in the Upper Aptian (= Clansayesian); a worldwide distributed species in the Lower and Upper Cretaceous of the Temperate and Tethyan facies realms, without any particular stratigraphic value.

*Dentalina gracilis* D'ORBIGNY 1839

Pl. 2, Fig. 8-9

v. 1979a *Dentalina gracilis* D'ORBIGNY, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 20, Pl. 3, Fig. 10.

*Occurrence.* – Bulgaria: Upper Barremian and Bedoulian rare; North West Germany: Barremian to Albian infrequent; a worldwide distributed species in the Lower and Upper Cretaceous of the Temperate and Tethyan facies realms, without any particular stratigraphic value.

*Dentalina guttifera* D'ORBIGNY 1846

Pl. 2, Fig. 10

v. 1975 *Dentalina guttifera* D'ORBIGNY, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 40, Pl. 3, Fig. 4.

*Occurrence.* – Bulgaria: Bedoulian; North West Germany: mostly unnamed because of the rarity of such specimens. Here, in the Barremian, we prefer the species name *Dentalina subguttifera* BARTENSTEIN 1952 for roughly similar but morphologically different tests. *Dentalina guttifera*, originally described from the Vienna Tertiary, is also known from citations in the Lower and Upper Cretaceous throughout the world.

*Dentalina linearis* (ROEMER 1841)

Pl. 2, Fig. 11

v. 1979a *Dentalina linearis* (ROEMER), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 20, Pl. 3, Fig. 3.

*Occurrence.* – Bulgaria: Bedoulian very rare; North West Germany and worldwide: in the Temperate and Tethyan facies realms throughout the Lower Cretaceous, common to very rare and without any particular stratigraphic value.

*Dentalina nana* REUSS 1863

Pl. 2, Fig. 12-13

1979 *Dentalina nana* REUSS, LOFALDLI & THUSU, Palaeontology 22/2, p. 422, Pl. 47, Fig. 22.



*Occurrence.* – Bulgaria: Gargasian and Clansayesian; North West Germany: throughout the Lower Cretaceous, very rare, but in the Aptian and Albian more common; a worldwide distributed species in the Lower Cretaceous, Temperate and Tethyan facies realms, without any particular stratigraphic value.

*Frondicularia filocincta* REUSS 1863

Pl. 2, Fig. 14

v.1975 *Frondicularia filocincta* REUSS, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 40, Pl. 2, Fig. 8.

*Occurrence.* – Bulgaria: Bedoulian and Gargasian; North West Germany: throughout the Lower Cretaceous, mostly very rare. According to systematic considerations (BARTENSTEIN & BRAND 1951, p.304), this species and a certain number of other species in the Lower Cretaceous, e.g. *F. ungeri* REUSS 1863 and *F. fusiformis* REUSS 1863, should belong to the synonymy of *F. inversa* REUSS 1845, originally described in the Bohemian Upper Cretaceous.

*Index Foraminifera in Figure 4*

*Frondicularia hastata* ROEMER 1842

Pl. 2, Fig. 15–16

v.1979a *Frondicularia hastata* ROEMER, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 20, Pl. 3, Fig. 2.

*Occurrence.* – Bulgaria: Hauterivian to Bedoulian, the same as in Rumania; North West Germany: Middle Valanginian to highest Lower Aptian (= Bedoulian in Bulgaria); England: Lower Hauterivian to Middle Barremian, rare; a good index Foraminifer in the deeper Lower Cretaceous, the so-called Neocomian, of the northern hemisphere, distributed in the Temperate and Tethyan facies realms.

*Frondicularia inversa* REUSS 1845

Pl. 2, Fig. 17–18

v.1975 *Frondicularia inversa* REUSS, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 41, Pl. 3, Fig. 6.

*Occurrence.* – Bulgaria: Barremian to Middle Aptian (= Gargasian); North West Germany: Lower and Upper Cretaceous; England: Berriasian to Hauterivian and Albian. The species is distributed in the Cretaceous of the northern hemisphere and has no particular stratigraphic value. (See also *F. filocincta* REUSS 1863.)

*Frondicularia loryi* BERTHELIN 1880

Pl. 2, Fig. 19–20

v.1977 *Frondicularia loryi* BERTHELIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 7, p. 38, Pl. 1, Fig. 13.

*Occurrence.* – Bulgaria: only Clansayesian; Rumania: Hauterivian to Albian; North West Europe and North West Germany: Lower Cretaceous, very rare. The species is distributed in the Temperate and Tethyan facies realms of the northern hemisphere. Its morphological arrangement changes between the genera *Frondicularia* and *Lingulina*. *Lingulina furcillata* BERTHELIN shows a microspheric stage,

*Frondicularia loryi* a megaspheric stage: both belong to the same species name *F. loryi* BERTHELIN (BARTENSTEIN 1954, p. 48–49, Pl. 1, Fig. 16).

*Frondicularia perovata* CHAPMAN 1894

Pl. 2, Fig. 21–22

v. 1975 *Frondicularia perovata* CHAPMAN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 41, Pl. 1, Fig. 1.

*Occurrence.* – Bulgaria: Hauterivian to Gargasian; North West Europe and North West Germany: throughout the Lower Cretaceous, but always very rare and without any particular stratigraphic value.

Some tests show a *Flabellinella* like primordial stage. Because of a relatively great variability of tests, a specific allocation to CHAPMAN'S *Frondicularia perovata* has not been made in most cases.

Occurrence of the genus *Lagena* WALKER & BOYS 1784  
in the Lower Cretaceous

The specific determination of *Lagena* tests in the Lower Cretaceous is sometimes very difficult, as reported in BARTENSTEIN & BRAND (1951, p. 316); BARTENSTEIN, BETTENSTAEDT & BOLLI (1957, p. 40); BARTENSTEIN & BETTENSTAEDT (1962, p. 255 and 265) and BARTENSTEIN & BOLLI (1973, p. 407).

We therefore describe the two following *Lagena* species as “affinis” to avoid any conclusive specific determination until more Bulgarian material has been examined.

*Lagena* aff. *apiculata* (REUSS 1851)

Pl. 2, Fig. 23–25; Pl. 5, Fig. 21

v. 1968 *Lagena apiculata* (REUSS), KOVATCHEVA, Bull. geol. Inst. (Sofia), Ser. Paleont. 17, p. 17, Pl. 3, Fig. 5.

*Occurrence.* – Bulgaria: Barremian and Aptian very rare; North West Europe and North West Germany: throughout the Lower Cretaceous and persisting to the Upper Cretaceous, common to rare; a species of the Temperate and Tethyan facies realms without any particular stratigraphic value.

*Lagena* aff. *hauteriviana* BARTENSTEIN & BRAND 1951

Pl. 2, Fig. 26–27

v. 1973 *Lagena hauteriviana hauteriviana* BARTENSTEIN & BRAND, BARTENSTEIN & KAEVER, Senckenb. Lethaea 54/2–4, p. 223, Pl. 2, Fig. 24.

*Occurrence.* – Bulgaria: Bedoulian and Clansayesian; North West Germany and North West Europe: Hauterivian common, with a few successors in the (Middle) Barremian.

Specific determination of the Lenticulinae  
in the Lower Cretaceous

As explained in detail by BARTENSTEIN, BETTENSTAEDT & BOLLI (1957, p. 12–13 and 22) and repeated by the same authors (1966, p. 145–151), for some *Lenticulina*



species, particular specific determinations of various, as a rule unornamented Lenticulinae are in many cases nearly impossible. Some species in Europe, North West Germany and/or in Bulgaria are no more than locally developed and limited forms, frequently with similar shape of test, chambering, costosity and/or ornamentation. This problem is well known for the Lenticulinae in the Lower and Middle Jurassic, Lower and Upper Cretaceous as well as in the (Lower) Tertiary.

We therefore prefer the symbol "aff." for questionable specific determination of some species, especially of the subgenus *Lenticulina*.

*Lenticulina (Astacolus) calliopsis* (REUSS 1863)

Pl. 2, Fig. 28

v.1975 *Astacolus calliopsis* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 39, Pl. 3, Fig. 9–10.

1979 *Astacolus* aff. *calliopsis* (REUSS), MUSACCHIO, Ameghiniana 16/3–4, p. 258, Pl. 4, Fig. 9–10.

*Occurrence.* – Bulgaria: Upper Barremian and Bedoulian; North West Germany: throughout the Lower Cretaceous, but its distribution is regarded as characteristic of the high Lower Cretaceous, Albian, also of North West Europe. The species shows a relatively variable growth of the tests (BARTENSTEIN & BRAND 1951; BARTENSTEIN, BETTENSTAEDT & BOLLI 1966). It has no particular stratigraphic value.

*Lenticulina (Astacolus) crepidularis* (ROEMER 1842)

Pl. 2, Fig. 29–32

v.1979a *Planularia crepidularis* (ROEMER), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 4, Fig. 3.

*Occurrence.* – Bulgaria: Hauterivian to Gargasian infrequent; North West Germany and worldwide: (Middle) Jurassic to Berriasian to Middle Aptian (= Gargasian). The species is distributed in the Temperate and Tethyan facies realms of both hemispheres.

Growth optima of comparatively smaller and narrower *Astacolus* and *Planularia* tests respectively (*crepidularis* types) can be distinguished from larger, stronger and compressed *Planularia* tests (*tricarinella* types) at various stratigraphic levels and in different regions.

*Lenticulina (Astacolus) planiuscula* (REUSS 1863)

Pl. 2, Fig. 33–34

1979 *Lenticulina (A.) planiuscula* (REUSS), SPROVIERI, Lav. Ist. Geol. (Palermo) 14, p. 4, 6, Pl. 1, Fig. 40; Pl. 2, Fig. 27.

*Occurrence.* – Bulgaria: Upper Barremian and Gargasian very rare; North West Europe and North West Germany: Aptian and Albian also rare. It also occurs in the Upper Aptian and Lower Albian of Trinidad, and in the Barremian and Aptian of Sicily.

*Lenticulina (Astacolus) schloenbachi* (REUSS 1863)

Pl. 2, Fig. 35

1975 *Marginulinopsis schloenbachi schloenbachi* (REUSS), NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p. 66, with 28 Fig. [non *schloembachi*].

1979 *Astacolus schloenbachi* (REUSS), MUSACCHIO, *Ameghiniana* 16/3-4, p.258, Pl.4, Fig.22; Text-fig.3 [non *schloembachi*].

*Occurrence.* – Bulgaria: Upper Barremian to Clansayesian; North West Europe and North West Germany: throughout the Lower Cretaceous (type horizon: Upper Hauterivian and Barremian) always rare and without any particular stratigraphic value.

The species is distributed in nearly all Lower Cretaceous deposits throughout the world but with numerous specimens apparently transitional to other *Lenticulina* species, e.g. *L. (A.) scitula* (BERTHELIN), *L. (A.) grata* (REUSS) and *L. (A.) calliopsis* (REUSS).

According to BARTENSTEIN & BETTENSTAEDT (1962, p.285), certain specimens of *L. (A.) schloenbachi* occur only from (Middle) Barremian to Middle Albian in the Boreal, as well as in the Mediterranean facies realms. This observation corresponds to the occurrences in Bulgaria.

BARTENSTEIN, BETTENSTAEDT & BOLLI (1966, p.149) placed specimens, found in the Lower Cretaceous of North West Germany, in the synonymy of *L. (A.) scitula* (BERTHELIN), found in the Upper Aptian to Lower Albian of Trinidad. We believe that here also, within the cited *Astacolus* species, a relatively broad variability prevails.

*Lenticulina (Astacolus) scitula* (BERTHELIN 1880)

Pl.2, Fig.36-37

v.1979a *Astacolus scitululus* (BERTHELIN), KOVATCHEVA, *Palaeont. Stratigr. Lithol.* 10, p.14, Pl.3, Fig.7.

*Occurrence.* – Bulgaria: Upper Barremian and Aptian; North West Europe and North West Germany: Barremian to Albian; Sicily: Barremian and Aptian; a cosmopolitan species of the higher Lower Cretaceous in the Boreal and Tethyan facies realms.

*Lenticulina (Lenticulina) gaultina* (BERTHELIN 1880)

Pl.3, Fig.1-2

v.1979 *Lenticulina (L.) gaultina* (BERTHELIN), BARTENSTEIN, *Newsl. Stratigr.* 7/3, p.150, Table 2.

*Occurrence.* – Bulgaria: Middle Aptian to Upper Albian; North West Germany and worldwide: (Lower to Middle) Aptian and Albian; a good index Foraminifer for the higher Lower Cretaceous in the Temperate and Tethyan facies realms.

This species has developed from *Lenticulina (L.) subgaultina* BARTENSTEIN 1962.

*Lenticulina (Lenticulina) heiermanni* BETTENSTAEDT 1952

Pl.3, Fig.3

v.1977 *Lenticulina (L.) heiermanni* BETTENSTAEDT, BARTENSTEIN, *Newsl. Stratigr.* 6/1, p.37, Table 2.

*Occurrence.* – Bulgaria: Barremian and Bedoulian; North West Germany: Uppermost Hauterivian to Lower Aptian (= Bedoulian in Bulgaria), rare but very typical; a good index Foraminifer in the European Boreal and Mediterranean facies realms, distributed from Upper Hauterivian to Lower Aptian.

*Lenticulina (Lenticulina) muensteri* (ROEMER 1839)

Pl. 3, Fig. 4-5

v.1979a *Lenticulina muensteri* (ROEMER), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 15.

*Occurrence.* – This species is distributed in the Lower Cretaceous of Bulgaria, North West Germany, and worldwide in the Temperate and Tethyan facies realms; an ordinary and common species in the Jurassic and Cretaceous, mostly with various species names. *Lenticulina muensteri* has no particular stratigraphic value.

*Lenticulina (Lenticulina) nodosa* (REUSS 1863)

Pl. 3, Fig. 6-7

v.1979 *Lenticulina (L.) nodosa* (REUSS), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 143, Table 1.

*Occurrence.* – Bulgaria: Upper Hauterivian to Gargasian; North West Germany and North West Europe: Upper Berriasian to Lower Hauterivian; an excellent index Foraminifer with differing distribution in the Temperate (north and south) and the Tethyan (Mediterranean) facies realms (AUBERT & BARTENSTEIN 1976, p. 1-33): In the Boreal from Upper Berriasian to Lower Hauterivian, in the Tethys from Kimmeridgian-Tithonian to Upper Aptian and, locally, in the Cenomanian, in the South from Valanginian to Albian and, locally, into Cenomanian.

*Lenticulina (Lenticulina) ouachensis ouachensis* (SIGAL 1952)

Pl. 3, Fig. 8

v.1979a *Lenticulina ouachensis ouachensis* (SIGAL), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 17.

*Occurrence.* – Bulgaria and North West Germany: Upper Hauterivian to Lower Aptian (= Bedoulian), common to rare; a good index Foraminifer, distributed worldwide in the Temperate and Tethyan facies realms from (Upper) Valanginian to Lower Aptian.

*Lenticulina (Lenticulina) pulchella* (REUSS 1863)

Pl. 3, Fig. 9-10

v.1976a *Lenticulina pulchella* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 4, p. 30, Pl. 1, Fig. 3-4.

*Occurrence.* – Bulgaria: Gargasian and Clansayesian; North West Germany: Hauterivian to Middle Albian; Trinidad: Upper Aptian to Lower Albian; Sicily: Aptian; always very rare.

*Lenticulina (Lenticulina) aff. saxocretacea* BARTENSTEIN 1954

Pl. 3, Fig. 11-12

v.1979a *Lenticulina saxocretacea* BARTENSTEIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 21, Pl. 3, Fig. 9.

*Occurrence.* – Bulgaria: Barremian and Aptian; North West Germany: throughout the Lower Cretaceous. Up to now this species has been found in the Boreal facies realm of Europe and in the Tethyan facies realm of southern and eastern

Europe, Bavaria and Austria; Sicily: Barremian and Aptian; Rumania: Barremian to Albian; Trinidad, W.I.: Barremian to Albian.

*Lenticulina (Lenticulina) secans* (REUSS 1860)

Pl. 3, Fig. 13-14

- 1975 *Lenticulina secans* (REUSS), NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p.64, Pl.47, Fig.5-8.  
 v.1976a *Lenticulina secans* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 4, p.31, Pl.1, Fig.1-2.

*Occurrence.* – Bulgaria: Gargasian and Clansayesian; Rumania: Upper Hauterivian to Albian; North West Germany and North West Europe: only (Aptian and) Albian, without any particular stratigraphic value.

In the Lower Cretaceous of North West Germany, specimens have, in most cases, not been assigned to this Albian species.

*Lenticulina (Lenticulina) sternalis* (BERTHELIN 1880)

Pl. 3, Fig. 15

- v.1976a *Lenticulina sternalis* (BERTHELIN), KOVATCHEVA, Palaeont. Stratigr. Lithol. 4, p.31, Pl.1, Fig.8-9.

*Occurrence.* – Bulgaria: Gargasian and Clansayesian; Sicily: Aptian; North West Europe: Albian; very rare and without any particular stratigraphic value.

Until now there has been no necessity in North West Germany to determine this species name in the higher Lower Cretaceous.

*Lenticulina (Lenticulina) subangulata* (REUSS 1863)

- v.1975 *Lenticulina subangulata* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p.42, Pl.2, Fig.11-12.

*Occurrence.* – Bulgaria: Aptian; Rumania: Albian; Sicily: Barremian and Aptian; England: Hauterivian and Barremian; North West Germany: Valanginian and Hauterivian; according to REUSS (1863, p.74) only Upper Hauterivian, always rare. *Lenticulina subangulata* seems to be a common Lower Cretaceous species without any particular stratigraphic value, but it must not be confused with certain evolute growing specimens of *Lenticulina nodosa*. Similar specimens to those found in the Bulgarian Aptian, are published as *Lenticulina (Lenticulina)* species from the lower Upper Aptian of North West Germany, Emsland area, in BARTENSTEIN (1974, p.559, Pl.2, Fig.1-2).

*Lenticulina (Lenticulina) subgaultina* BARTENSTEIN 1962

Pl. 3, Fig. 16-17

- v.1979a *Lenticulina (L.) subgaultina* BARTENSTEIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.21, Pl.3, Fig.13.

*Occurrence.* – Bulgaria and Sicily: Aptian; North West Germany: Lower Aptian to Lower Albian rare; a good index Foraminifer distributed worldwide in the

Temperate (Boreal) and Tethyan facies realms and occurring only in the Aptian and Lower Albian, possibly as a predecessor to *Lenticulina* (*L.*) *gaultina* (BERTHELIN).

According to NEAGU (1975, p.59), *Lenticulina subgaultina* is also distributed in the Rumanian Hauterivian. A morphological study of these specimens would be useful to confirm this identification.

*Lenticulina* (*Lenticulina*) *turgidula* (REUSS 1863)

1979 *Lenticulina turgidula* (REUSS), SPROVIERI, Lav. Ist. Geol. Univ. (Palermo) 14, p.4, 6, Pl.1, Fig.34, 46.

*Occurrence.* – Bulgaria: Clansayesian and Lower Albian; Sicily: Barremian and Aptian; North West Germany and North West Europe: Aptian and Albian rare; distributed worldwide in the Aptian and Albian of the Temperate and Tethyan facies realms.

*Lenticulina* (*Marginulinopsis*) *djaffaensis* (SIGAL 1952)

Pl.3, Fig.18

v.1979a *Marginulinopsis djaffaensis* SIGAL, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, Pl.4, Fig.11.

*Occurrence.* – Bulgaria: Upper Hauterivian to Bedoulian (= Lower Aptian); Sicily and Trinidad: Barremian; North West Europe and North West Germany: Upper Valanginian to Barremian; a worldwide distributed, excellent index Foraminifer occurring from higher Valanginian to Lower Aptian in the Temperate and Tethyan facies realms, but particularly notable in the Barremian.

According to BARTENSTEIN & KAEVER (1974, p.225, Pl.2, Fig.32–33), *Marginulinopsis djaffaensis* SIGAL 1952 and *Lenticulina* (*M.*) *sigali* BARTENSTEIN, BETTENSTAEDT & BOLLI 1957 are synonymous with *Lenticulina* (*M.*) *reticulosa* (DAM 1946).

*Lenticulina* (*Saracenaria*) *frankei* (DAM 1946)

Pl.3, Fig.19

v.1979a *Saracenaria frankei* TEN DAM, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p.21, Pl.3, Fig.8.

*Occurrence.* – Bulgaria: Upper Hauterivian to Bedoulian (= Lower Aptian); North West Germany and the Temperate facies realm: Lower Hauterivian to Upper Barremian; Tethyan facies realms: Upper Valanginian to Lower Aptian. The species is a good index Foraminifer, distributed worldwide, and is a predecessor to *Lenticulina* (*S.*) *forticosta* BETTENSTAEDT 1952 and to *Lenticulina* (*S.*) *spinosa* (EICHENBERG 1935).

*Lenticulina* (*Saracenaria*) *spinosa* (EICHENBERG 1935)

Pl.3, Fig.20–21

v.1979 *Lenticulina* (*S.*) *spinosa* (EICHENBERG), BARTENSTEIN, Newsl. Stratigr. 7/3, p.150, Table 2.

*Occurrence.* – The species is one of the best index Foraminifera in the Aptian or Bedoulian to Clansayesian, respectively, distributed worldwide in the Temperate and Tethyan facies realms. Bulgaria: Gargasian and Clansayesian; Sicily: Aptian; Trinidad: higher Lower Aptian to earliest Lower Albian; North West Germany and

North West Europe: deshayesi-Zone to nolani-Zone, according to the Bulgarian substages Bedoulian to Lower Clansayesian.

*Lenticulina (Vaginulinopsis) excentrica* (CORNUEL 1848)

Pl. 3, Fig. 22

- v. 1975 *Vaginulinopsis excentricus* (CORNUEL), KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 42, Pl. 2, Fig. 1-2.  
 1975 *Vaginulinopsis excentrica* (CORNUEL), NEAGU, Mém. Inst. Géol. Géophys. (Bucarest) 25, p. 71, Pl. 55, Fig. 5, 8-17, 20, 22-26.

*Occurrence.* – Bulgaria: Lower Barremian to Gargasian; Rumania: Valanginian to Lower Aptian; Sicily: Barremian and Aptian; Trinidad: Barremian to Lower Albian; North West Germany and North West Europe: throughout the Lower Cretaceous, always very rare and without any particular stratigraphic value. According to the citations, the species occurs in the Boreal and Tethyan facies realms of the northern hemisphere.

*Nodosaria obscura* REUSS 1845

Pl. 3, Fig. 23-24

- v. 1979a *Nodosaria obscura* REUSS, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, Pl. 3, Fig. 18.

*Occurrence.* – Bulgaria: Hauterivian to Gargasian; North West Germany and North West Europe: throughout the Lower and deeper Upper Cretaceous, common. The species is distributed worldwide, but without any particular stratigraphic value.

There exists a close relationship between *Marginulina pyramidalis* (KOCH 1851), originally described as *Nodosaria*, and *Nodosaria obscura* REUSS. The specimens differ only in the aspect of their last chamber and the aperture: *Nodosaria obscura* with a distinctly central opening, *Marginulina pyramidalis* with a slightly lateral shifted opening.

*Index Foraminifera in Figure 5*

*Palmula* aff. *dentonensis* LOEBLICH & TAPPAN 1941

Pl. 3, Fig. 25

- 1965 *Palmula asiatica* FURSENKO, JOVCHEVA, Le Crétacé inférieur (Sofia), Pl. 72, Fig. 2; Pl. 82, Fig. 5 (only Figures).

*Occurrence.* – Bulgaria: Clansayesian and Albian; Texas: (Middle? and) Upper Albian; USSR: according to FURSENKO higher Lower Cretaceous, probably Albian, of the North Caucase and South Emba area.

*Remarks.* – There exists a distinct number of *Palmula* species in the U.S. American Albian (FRIZZELL 1954, p. 96-97). We believe that *Palmula asiatica* belongs to these forms, but a comparison with the USSR species, published as *Palmula asiatica* FURSENKO 1949 by GORBACHIK & SCHOKHINA (1960, p. 98, Pl. 10, Fig. 1), is impossible without material from the type horizon and type locality.

*Palmula dentonensis* is a predecessor of *Palmula elliptica* (NILSSON 1827) in the European and German Albian and Upper Cretaceous, cited in FRANKE (1928, p. 91,



Pl. 8, Fig. 14–15) and, as *Palmula cordata* (REUSS 1845), in BARTENSTEIN (1948, p. 183, Fig. 9–10).

But it is more likely, that all specimens belong to a so-called “Rassenkreis” or a “genetic plexus” with only one species name, *Palmula elliptica* (NILSSON 1827), occurring from Upper Aptian to Upper Cretaceous in the Temperate as well as in the Tethyan facies realms.

*Length of specimens.* – Russian form (adult) 1.5 mm; Bulgarian form (only coiled portion and two chambers of the uncoiled portion) 0.7–0.75 mm; American form (adult) 3.1 mm, only coiled portion and two chambers of the uniserial portion 1 mm. *Palmula cordata* in the North West German Albian 1.14–1.46 mm, width 1.0–1.1 mm.

*Pseudonodosaria mutabilis* (REUSS 1863)

Pl. 3, Fig. 26

v. 1979a *Pseudonodosaria mutabilis* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 2, Fig. 22.

*Occurrence.* – Bulgaria: Upper Hauterivian to Clansayesian; North West Germany and the Temperate and Tethyan facies realms of the northern hemisphere: throughout the Lower Cretaceous. The species has no particular stratigraphic value.

There exists a close relationship to *P. humilis* (ROEMER 1841) and *P. tenuis* (BORNEMANN 1854): see BARTENSTEIN & BRAND (1951, p. 315–316).

*Pyrulina infracretacea* BARTENSTEIN 1952

Pl. 3, Fig. 27

v. 1975 *Pyrulina infracretacea* BARTENSTEIN, KOVATCHEVA, Palaeont. Stratigr. Lithol. 2, p. 43, Pl. 3, Fig. 14.

*Occurrence.* – Bulgaria: up to now only Bedoulian; Rumania: Valanginian to Lower Aptian; Sicily: Barremian and Aptian; North West Germany and North West Europe, Texas and Trinidad: according to MICHAEL 1967 throughout the Barremian, but always rare. The species is distributed worldwide in the Temperate and Tethyan facies realms.

*Ramulina aculeata* WRIGHT 1889

Pl. 3, Fig. 28

v. 1979a *Ramulina aculeata* WRIGHT, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 22, Pl. 2, Fig. 6.

*Occurrence.* – Bulgaria: Barremian to Gargasian; North West Germany and worldwide: throughout the Lower Cretaceous and persisting to Holocene and present oceans, common but without any particular stratigraphic value.

*Tristix acutangula* (REUSS 1863)

Pl. 3, Fig. 29–30

v. 1979a *Tristix acutangulus* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 16.

*Occurrence.* – Bulgaria: Upper Hauterivian to Clansayesian; North West Germany and other countries: throughout the Lower Cretaceous, very rare. The species is distributed worldwide, but has no particular stratigraphic value.

*Vaginulina arguta* REUSS 1860

Pl. 4, Fig. 1–2

v. 1979a *Vaginulina arguta* REUSS, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 6.

*Occurrence.* – Bulgaria: Upper Hauterivian to Clansayesian; Rumania: Valanginian to Albian; North West Germany, Europe and North America: entire Lower Cretaceous and persisting to the Cenomanian; a species distributed worldwide with no particular stratigraphic value.

*Vaginulina kochi* ROEMER 1841

Pl. 4, Fig. 3–4

v. 1979a *Vaginulina kochi* ROEMER, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 3, Fig. 11.

*Occurrence.* – Bulgaria: Upper Hauterivian to Gargasian (= Middle Aptian); Rumania: Upper Valanginian to Gargasian, the same distribution as in the Tethyan facies realm; North West Germany and Boreal facies realm: from Upper Valanginian to (Middle) Barremian; a good, useful, worldwide index Foraminifer.

*Conorotalites aptiensis* (BETTENSTAEDT 1952)

Pl. 4, Fig. 5

v. 1979 *Conorotalites aptiensis* (BETTENSTAEDT), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 150, Table 2.

*Occurrence.* – A good, useful and worldwide index Foraminifer in all facies realms, distributed from Uppermost Barremian to Lower, and with rare specimens in Middle Albian; in Bulgaria: Gargasian and Clansayesian; in North West Germany: high Barremian to Upper Aptian, nolani-Zone, and with single specimens in the Middle Albian. The species is a successor to *Conorotalites intercedens* (BETTENSTAEDT).

*Conorotalites intercedens* (BETTENSTAEDT 1952)

Pl. 4, Fig. 6–7

v. 1979a *Conorotalites intercedens* (BETTENSTAEDT), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 23, Pl. 2, Fig. 5.

*Occurrence.* – The species is an excellent index Foraminifer, distributed worldwide in the Middle and Upper Barremian of the Temperate and Tethyan facies realms; Bulgaria: Upper Barremian, but also Bedoulian; Sicily: Barremian; North West Germany: Middle and Upper Barremian, common. The species is a predecessor to *Conorotalites aptiensis* which begins in the high Barremian.

The restricted occurrence of *C. intercedens* in the Bulgarian Bedoulian contradicts the worldwide distribution, viz. only in the Barremian. We believe that this Bulgarian determination comprises no more than a variety of the true *C. aptiensis* (BETTENSTAEDT).



*Epistomina caracolla* (ROEMER 1841)

Pl. 4, Fig. 8

v. 1979 *Epistomina caracolla* (ROEMER), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 143, Table 1.

*Occurrence.* – Bulgaria: Hauterivian to Bedoulian; Rumania: Upper Valangian to Middle Barremian; North West Germany and North West Europe: (Middle) Berriasian to Lower Aptian (= Bedoulian); a good index Foraminifer distributed in the Temperate and Tethyan facies realms from Berriasian to Lower Aptian, infrequent. Very common in the Boreal realm.

*Epistomina chapmani* DAM 1948

Pl. 4, Fig. 9–10; Pl. 5, Fig. 22–23

v. 1979a *Epistomina chapmani* TEN DAM, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, Pl. 4, Fig. 8–9.

*Occurrence.* – A good index Foraminifer from Middle Barremian to Middle Albian (but lower and upper limit questionable); Bulgaria: entire Aptian; North West Germany and North West Europe: Middle Barremian to Middle Albian; western North Atlantic Ocean: higher Albian. According to BARTENSTEIN & BETTENSTAEDT 1962, *E. chapmani* occurs particularly in the Boreal facies realm.

*Epistomina colomi* DUBOURDIEU & SIGAL 1949

Pl. 4, Fig. 11–12

v. 1979a *Epistomina colomi* DUBOURDIEU & SIGAL, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 24, Pl. 4, Fig. 6–7.

*Occurrence.* – An index Foraminifer of the Mediterranean, occurring in the Bedoulian and Gargasian of Bulgaria, but elsewhere persisting to the Albian and Lower Cenomanian. The Boreal representative with similar stratigraphic distribution is *Epistomina spinulifera polypioides* (EICHENBERG 1933).

*Epistomina cretosa* DAM 1947

Pl. 4, Fig. 13–14; Pl. 5, Fig. 32

v. 1979a *Epistomina cretosa* TEN DAM, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 25, Pl. 4, Fig. 4–5.

*Occurrence.* – Bulgaria: Aptian; Rumania: Upper Barremian and Lower Aptian; North West Germany and Netherlands: Upper Aptian and Albian; worldwide: from Upper Hauterivian to Albian (OHM 1967).

According to BARTENSTEIN (1977, p. 33), *E. cretosa* is a younger synonym of *E. spinulifera polypioides* (EICHENBERG 1933). In this particular case, *E. spinulifera polypioides* is distributed worldwide in the Boreal and Tethyan facies realms and is a good index Foraminifer for the Aptian and Albian.

*Epistomina reticulata* (REUSS 1863)

Pl. 4, Fig. 15–16; Pl. 5, Fig. 24–25

v. 1979 *Epistomina reticulata* (REUSS), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 150, Table 2.

*Occurrence.* – Bulgaria: Gargasian and Clansayesian; North West Germany and North West Europe: (Middle) Aptian to (Upper) Albian; a relatively good index Foraminifer, distributed in the Boreal and Tethyan facies realms of the northern hemisphere.

*Epistomina spinulifera* (REUSS 1863)

Pl. 4, Fig. 17

v. 1979a *Epistomina spinulifera* (REUSS), KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 25, Pl. 4, Fig. 1-2.

*Occurrence.* – Bulgaria: Barremian to Albian; North West Germany: Middle Barremian to Albian and persisting to Cenomanian (probably Santonian according to OHM (1967), rare, only locally infrequent, a good index form.

The species which has a worldwide distribution in the Boreal and Tethyan areas ranges from Middle Barremian to Upper Albian and into the deeper Upper Cretaceous.

*Gavelinella barremiana* BETTENSTAEDT 1952

Pl. 4, Fig. 18-19

v. 1979 *Gavelinella barremiana* BETTENSTAEDT, BARTENSTEIN, Newsl. Stratigr. 7/3, p. 148, Table 2.

*Occurrence.* – This species is distributed worldwide from Middle Barremian to Lower Aptian in the Temperate and Tethyan facies realms as an excellent index Foraminifer; Bulgaria: Upper Barremian and Bedoulian; North West Germany: Middle Barremian to Lower Aptian (= Bedoulian), common.

*G. barremiana* has developed during the Lower Barremian from *G. sigmoicosta* (DAM 1948), and is the predecessor to *G. intermedia* (BERTHELIN 1880).

*Gavelinella intermedia* (BERTHELIN 1880)

Pl. 4, Fig. 20-21

v. 1979 *Gavelinella intermedia* (BERTHELIN), BARTENSTEIN, Newsl. Stratigr. 7/3, p. 150, Table 2.

*Occurrence.* – This species is distributed worldwide from Lower Aptian to Upper Albian in the Temperate and Tethyan facies realms, and persisting to the Upper Cretaceous as an excellent index Foraminifer; Bulgaria: Gargasian and Clansayesian; North West Germany: Lower Aptian, *deshayesi* Zone, Albian and persisting into the Cenomanian. *G. intermedia* has developed from *G. barremiana*.

*Globigerinelloides algerianus* CUSHMAN & DAM 1948

Pl. 4, Fig. 22-23; Pl. 5, Fig. 29

1978 *Globigerinelloides algerianus* CUSHMAN & DAM, GRADSTEIN, Init. Rep. Deep Sea Drill. Proj. 44, Pl. 10, Fig. 9-13; Textfig. 3-4.

*Occurrence.* – This species is distributed only in the upper portion of the Gargasian (= Middle Aptian) and distinctly below the boundary to the Clansayesian (MOULLADE 1966, p. 124-125). It is an excellent, short-lived index Foraminifer. The same may belong to other occurrences of the Tethys; in Bulgaria observed only in the Clansayesian (= Upper Aptian).

We cannot decide on the validity of *Biglobigerinella barri* BOLLI, LOEBLICH & TAPPAN 1957 or on its synonymy to *G. algerianus* according to KUHRY 1971. We agree with KUHRY's opinion of a possible phylogenetic sequence between *B. barri*, *G. ferreolensis* (MOULLADE 1961) [or synonymous to *G. bentonensis* (MORROW 1934)?], *G. algerianus* and their intermediate forms in the Aptian to (lowermost) Albian of the Tethyan facies realm and its marginal areas.

Taking into account the Bulgarian publications and concepts, we choose the species name *G. algerianus*, but this is contrary to the first author's opinion.

*Hedbergella infracretacea* (GLAESSNER 1937)

Pl. 4, Fig. 24–25; Pl. 5, Fig. 26–27

v. 1979 *Hedbergella infracretacea* (GLAESSNER), BARTENSTEIN, *Newsl. Stratigr.* 7/3, p. 146, Table 1.

*Occurrence.* – Bulgaria: Bedoulian to Cenomanian, rare; North West Germany and North West Europe: Barremian to Cenomanian, common; a worldwide distributed planktonic index Foraminifer occurring in the Temperate and Tethyan facies realms.

*Hedbergella planispira* (TAPPAN 1940)

Pl. 4, Fig. 26; Pl. 5, Fig. 28

1979 *Hedbergella planispira* (TAPPAN), SIGAL, *Init. Rep. Deep Sea Drill. Proj.* 47/2, Pl. 3, Fig. 23–24; Table 1.

*Occurrence.* – Bulgaria: Clansayesian (= Upper Aptian) and Albian; Trinidad: Upper Aptian to Upper Cretaceous; North West Germany: Albian and Cenomanian; a planktonic index Foraminifer known worldwide, distributed from Upper Aptian to Cenomanian in the Temperate and Tethyan facies realms.

*Hedbergella tardita* (ANTONOVA 1964)

Pl. 4, Fig. 27–28; Pl. 5, Fig. 38–39

\*1964 *Globigerina tardita* ANTONOVA, *Trudy K.F.V.N.I.I.* 12, p. 60, Pl. 12, Fig. 4–5.

v. 1977 *Hedbergella washitensis* (CARSEY), KOVATCHEVA, *Palaeont. Stratigr. Lithol.* 7, p. 40, Pl. 1, Fig. 16–18 [non *H. washitensis*].

v. 1979 *Hedbergella tardita* AGALAROVA, SIGAL, *Init. Rep. Deep Sea Drill. Proj.* 47/2, p. 291, Pl. 2, Fig. 11–12 [non AGALAROVA].

*Occurrence.* – Bulgaria: only Clansayesian; USSR: Barremian to Lower Aptian; Vigo Seamount 175 km west of Portugal: Late Aptian; a Tethyan index Foraminifer now known from offshore South West Europe to East Europe (Caucase).

*Diameter of specimens.* – Bulgaria 0.25–0.27 mm, USSR 0.15–0.20 mm, offshore Portugal 0.1 mm.

*Lamarckina lamplughi* (SHERLOCK 1914)

Pl. 4, Fig. 29–30; Pl. 5, Fig. 30–31

v. 1979a *Lamarckina lamplughi* (SHERLOCK), KOVATCHEVA, *Palaeont. Stratigr. Lithol.* 10, p. 24, Pl. 1, Fig. 10–12.

*Occurrence.* – Bulgaria: Barremian to Middle Albian; Rumania: Albian; North West Germany and North West Europe: Upper Hauterivian to Lower Albian rare,

but infrequent to frequent in the Barremian and Lower Albian; a good index Foraminifer in the Boreal and Tethyan facies realms distributed from Upper Hauterivian to Upper Albian.

*Planomalina caseyi* BOLLI, LOEBLICH & TAPPAN 1957

Pl. 4, Fig. 31–32; Pl. 5, Fig. 33–34

v. 1977 *Planomalina caseyi* BOLLI, LOEBLICH & TAPPAN, Kovatcheva, Palaeont. Stratigr. Lithol. 7, p. 39, Pl. 1, Fig. 11–12.

1979 *Globigerinelloides caseyi* (BOLLI, LOEBLICH & TAPPAN), SIGAL, Init. Rep. Deep Sea Drill. Proj. 47/2, Pl. 4, Fig. 21; Table 1.

*Occurrence.* – Bulgaria: Clansayesian and Albian; Texas: uppermost Albian, basal Cenomanian and Turonian; England: Gault (Albian = type locality of *Pl. caseyi*); North West Germany: basal Cenomanian; “Blake Plateau”: Cenomanian. The species is a good index Foraminifer distributed in the Boreal and Tethyan facies realms of the northern hemisphere.

According to LOEBLICH & TAPPAN (1961, p. 268), *Pl. caseyi* is a younger synonym of *Globigerinelloides eaglefordensis* (MOREMAN 1927). According to HOFKER (1960, p. 315–322), *Praeglobotruncana*, *Planomalina*, *Globigerinella* and *Biglobigerinella* have no biological significance as genera; they are merely transitional stages in several developmental series. And the “*Globigerina caseyi* group” in the Albian is no more than a particular developmental series but without real biological significance. According to J. Sigal (written information from 15 January 1978), the Bulgarian specimens of *Pl. caseyi* belong to the species *Globigerinelloides ferreolensis* (MOULLADE).

Therefore, we believe that no conclusive decision can be given to the true systematic position of these Bulgarian forms.

*Ticinella roberti* (GANDOLFI 1942)

Pl. 4, Fig. 33–34; Pl. 5, Fig. 35–36

v. 1977 *Ticinella roberti* (GANDOLFI), Kovatcheva, Palaeont. Stratigr. Lithol. 7, p. 40, Pl. 1, Fig. 19–21.

1979 *Ticinella roberti* (GANDOLFI), SIGAL, Init. Rep. Deep Sea Drill. Proj. 47/2, Pl. 4, Fig. 9–10; Table 1.

*Occurrence.* – Bulgaria: Clansayesian and Albian. The species is distributed in the Middle and Upper Albian and Lower Cenomanian of the predominantly Tethyan facies realm, with occurrences reported from: East Atlantic, North Africa, Italy, South Switzerland, Tanganyika.

It appears that *T. roberti* has evolved from *Hedbergella delrioensis* (CARSEY 1926).

*Valvulineria loetterlei* (TAPPAN 1940)

Pl. 4, Fig. 35–36; Pl. 5, Fig. 45–46

v. 1979 *Valvulineria loetterlei* (TAPPAN), Bartenstein, Newsl. Stratigr. 7/3, p. 150, Table 2.

*Occurrence.* – Bulgaria: Bedoulian to Albian; North West Germany: (Upper) Aptian to Cenomanian, common; worldwide: from (Middle) Barremian to Cenoma-

nian-Turonian, distributed in the Temperate and Tethyan facies realms. This species is useful as an index Foraminifer only in the higher Lower Cretaceous.

*Valvulineria gracillima* DAM 1947 is a younger synonym to *V. loetterlei*.

*Patellina subcretacea* CUSHMAN & ALEXANDER 1930

Pl. 4, Fig. 37

v. 1979 *Patellina subcretacea* CUSHMAN & ALEXANDER, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 2, Fig. 29-31.

Occurrence. – This species is distributed throughout the Lower Cretaceous, in Bulgaria, North West Germany and worldwide in the Temperate and Tethyan facies realms, mostly rare; a species without any particular stratigraphic value.

*Spirillina minima* SCHACKO 1892

Pl. 4, Fig. 38-39; Pl. 5, Fig. 43-44

v. 1979a *Spirillina minima* SCHACKO, KOVATCHEVA, Palaeont. Stratigr. Lithol. 10, p. 14, Pl. 2, Fig. 26.

Occurrence. – Bulgaria: Upper Hauterivian to Clansayesian; North West Germany and worldwide: Lower and Upper Cretaceous; a species without any particular stratigraphic value.

### Stratigraphy and paleogeography

Aptian deposits in Bulgaria are widespread and of diverse facies (Fig. 1). Their stratigraphic subdivision is based on the results of studies of the faunistic and lithologic sequences mainly in two different tectonic regions: the Fore-Balkan and the Moesian Platform.

The Aptian stage is subdivided into three substages and four ammonite zones (Fig. 2): Bedoulian with *Deshayesites deshayesi* Zone, Gargasian with *Aconeceras nisum* and *Chelonoceras subnodocostatum* Zones, and Clansayesian with *Diadochoceras nodocostatum* Zone (NIKOLOV 1965).

In the Fore-Balkan the Bedoulian substage is better developed while the Gargasian substage is of restricted occurrence. Both are represented by a marked terrigenous facies with lenses of Urganian-type sediments. To the north, the terrigenous deposits gradually pass into clay-carbonate and carbonate (Urganian inclusive) facies of the Moesian Platform.

The Clansayesian substage is of restricted occurrence. In both areas, the Fore-Balkan (in its western part) and the Moesian Platform, the Clansayesian is represented exclusively as a marly facies with rare intercalations of clayey limestones.

The paleogeographic environment during the Aptian stage differs from the preceding stages of the Lower Cretaceous; its deposition took place in a relatively shallow marine basin.

In the area of the Fore-Balkan, characterized by a mobile tectonic regime with intensive subsidence, terrigenous material was supplied from the south. There were, however, several uplifted areas where the influx of terrigenous material was relative-

ly small and conditions for biogenic and chemical sedimentation existed. These areas at the same time were a barrier for the terrigenous material which divided the quiet sedimentation regime of the Moesian Platform. There, diverse limestones and marls were formed (NIKOLOV & KHRISCHEV 1965, NIKOLOV 1969).

In general, the Bulgarian Aptian benthonic and planktonic Foraminifera compare well with those in other parts of the world, distributed in the northern Temperate (Boreal), the Tethyan (Mediterranean) and sporadically also in the southern Temperate area. The following index forms are regarded as being of particular significance in the Aptian of Bulgaria and North West Germany, whose synopsis is the principal aim of this publication (explanation of bracket notes and marks at the end of this list).

A. Worldwide distributed species occurring in the Temperate  
and Tethyan facies realms:

<i>Falsogaudryinella moesiana</i>	(lower limit)
<i>Marssonella kummi</i>	(upper limit)
<i>M. subtrochus</i>	(transition zone)
<i>Textularia bettenstaedti</i>	(transition zone)
<i>Triplasia georgsdorfensis</i>	(upper limit)
<i>Tritaxia pyramidata</i>	(transition zone in the Tethys; lower limit in the Boreal)
<i>Pleurostomella reussi</i>	(lower limit)
<i>Citharina acuminata</i>	(transition zone)
<i>Frondicularia hastata</i>	(upper limit)
<i>Lenticulina (A.) crepidularis</i>	(upper limit)
<i>L. (A.) planiuscula</i>	(transition zone)
<i>L. (A.) scitula</i>	(transition zone)
<i>L. (L.) gaultina</i>	(lower limit)
<i>L. (L.) heiermanni</i>	(upper limit)
<i>L. (L.) nodosa</i>	(upper limit only in the Tethys)
<i>L. (L.) ouachensis ouachensis</i>	(upper limit)
<i>L. (L.) subgaultina</i>	(lower limit)
<i>L. (L.) turgidula</i>	(lower limit)
<i>L. (L.) djaffaensis</i>	(upper limit)
<i>L. (S.) frankei</i>	(upper limit)
<i>L. (S.) spinosa</i>	(entire Aptian) + +
<i>Vaginulina kochi</i>	(upper limit in the Tethys; absent in the Boreal)
<i>Conorotalites aptiensis</i>	(entire Aptian) + +
<i>C. intercedens</i>	(questionable in the Bedoulian; absent in the Boreal)
<i>Epistomina caracolla</i>	(upper limit)
<i>E. chapmani</i>	(transition zone)
<i>E. cretosa</i>	(probably lower limit)
<i>E. reticulata</i>	(lower limit)
<i>E. spinulifera</i>	(transition zone)
<i>Gavelinella barremiana</i>	(upper limit)
<i>G. intermedia</i>	(lower limit)
<i>Hedbergella infracretacea</i>	(transition zone, but in Bulgaria lower limit)
<i>H. planispira</i>	(lower limit)
<i>Lamarckina lamplughii</i>	(transition zone)
<i>Planomalina caseyi</i>	(lowermost limit, but questionable)
<i>Valvulineria loetterlei</i>	(lower limit)



B: *Tethyan* species of worldwide significance  
(in North West Germany absent):

<i>Gaudryina reicheli</i>	(Upper Aptian) + +
<i>Marssonella praeoxycona</i>	(transition zone)
<i>Pseudocyclammina</i> aff. <i>cylindrica</i>	(transition zone)
<i>Palmula</i> aff. <i>dentonensis</i>	(lower limit)
<i>Epistomina colomi</i>	(lower limit)
<i>Globigerinelloides algerianus</i>	(Upper Aptian) + +
<i>Ticinella roberti</i>	(lowermost limit, but questionable)

Explanation of the list

Aptian as *transition zone* means that the respective index species appears in older formations than Aptian and disappears in younger formations.

Aptian as *upper limit of distribution* means that the respective index species disappears in the Aptian.

Aptian as *lower limit of distribution* means that the respective index species appears in the Aptian.

+ +: This mark means that the respective species is an excellent index Foraminifer in the Aptian, mainly occurring in this stage.

(questionable): Occurrence in Bulgaria questionable according to the known worldwide distribution of the respective species.

A certain number of benthonic Foraminifera are restricted to the Urgonian and para-Urgonian type of sediments in the Bulgarian Aptian, viz. reef and reef-like deposits, organic detrital sediments and oolitic or pseudo-oolitic clayey limestones (KOVATCHEVA 1979, p.28). This facies type has no equivalent deposits in North West Europe.

Because of the fact that the respective foraminiferal species are mostly absent in North West Germany, we publish only their names.

○ = exclusively distributed in Tethyan (Mediterranean) areas

+ = also distributed in North West Germany and/or North West Europe

- *Choffatella decipiens* SCHLUMBERGER 1905 (Pl. 4, Fig. 40–41). Distribution: Bedoulian to Gargasian.
- *Ammomarginulina loricata* LOEBLICH & TAPPAN 1949 (Pl. 4, Fig. 42–43; Pl. 5, Fig. 47). Distribution: Bedoulian.
- *Trocholina aptiensis* JOVCHEVA 1962 (Pl. 4, Fig. 44–45). Distribution: Bedoulian to Gargasian.
- + *Trocholina infragranulata* NOTH 1951 (Pl. 4, Fig. 46–47). Distribution: Bedoulian to Gargasian.
- *Arenobulimina meltae* KOVATCHEVA 1969 (Pl. 4, Fig. 48–50; Pl. 5, Fig. 40–42). Distribution: Bedoulian.
- *Flabellamina urgonensis* n. sp. (Pl. 1, Fig. 26–27). Distribution: Bedoulian to Gargasian.
- + *Citharina intumescens* (REUSS 1863) (Pl. 5, Fig. 1–2). Distribution: Bedoulian.
- *Lenticulina (Lenticulina) praegaultina* BARTENSTEIN, BETTENSTAEDT & BOLLI 1957 (Pl. 5, Fig. 3–4). Distribution: Bedoulian.
- + *Bolivina textilarioides* REUSS 1863 (Pl. 5, Fig. 5–6). Distribution: Bedoulian.
- *Ammobaculites torosus* LOEBLICH & TAPPAN 1949 (Pl. 5, Fig. 7–8). Distribution: Bedoulian to Gargasian.
- *Verneuilinoides schizeus* (CUSHMAN & ALEXANDER 1930) (Pl. 4, Fig. 51; Pl. 5, Fig. 37). Distribution: Bedoulian.
- *Palorbitolina lenticularis* (BLUMENBACH 1805) (Pl. 5, Fig. 9–10). Distribution: Bedoulian to Clansayesian.
- *Ammobaculoides carpathicus* GEROCH 1966 (Pl. 5, Fig. 11). Distribution: Bedoulian.

This list deals only with the distribution of the respective species in the Bulgarian Aptian, without regard to older and younger Lower Cretaceous substages or to occurrences outside of Bulgaria.

It is amazing that hitherto no joint stratigraphic comparison of the Lower Cretaceous deposits and their foraminiferal facies has been published in Bulgaria and Rumania similar to publications in Central and North West Europe twenty or more years ago: e.g. BETTENSTAEDT & WICHER (1955), BARTENSTEIN & BETTENSTAEDT (1962).

NEAGU'S survey (1975, Table 1) is no more than a generalization of European occurrences without a systematic comparison of their foraminiferal species and their stratigraphic distribution.

In our opinion, COSTEA'S publication (1974) about the micropaleontological subdivision of the Lower Cretaceous in the central part of the Moesian Platform (Rumania) shows nearly the same facies provinces and foraminiferal assemblages, but without the systematic revision, as known from the Barremian, Aptian and Albian in Bulgaria (e.g. KOVATCHEVA 1979b). In future, a detailed comparison of the Lower Cretaceous in Bulgaria, Rumania and neighbouring sedimentary areas of the USSR with systematic analyses of their index Foraminifera should be an important and urgent task and that a comparison should be made species by species, facies type by facies type. We are sure, that a lot of recently designated new species and/or subspecies will be invalid and that few micropaleontological and microstratigraphical differences between Bulgaria and Rumania will exist.

#### REFERENCES

- ANTONOVA, Z. A., SHMIGINA, T. A., GNEDINA, A. G., & KALUGINA, O. M. (1964): *Foraminiferi neocoma i apta Mejdurecia Psheha-Ubin*. - Trudy K.F.V.N.I.I. 12, 3-72.
- ASCOLI, P. (1976): *Foraminiferal and Ostracod biostratigraphy of the Mesozoic-Cenozoic, Scotian Shelf, Atlantic Canada*. - Spec. Publ. Marit. Sed. 1, 653-771.
- AUBERT, J., & BARTENSTEIN, H. (1976): *Lenticulina (L.) nodosa, additional observations in the worldwide Lower Cretaceous*. - Bull. Cent. Rech. Pau-SNPA 10/1, 1-33.
- BARTENSTEIN, H. (1948): *Untersuchungen zur Systematik und Stratigraphie der Flabellina-gestaltigen Foraminiferen*. - Erdöl u. Kohle 1/6, 180-184.
- (1954): *Revision von Berthelin's Mémoire 1880 über die Alb-Foraminiferen von Montcley*. - Senckenbergiana 35, 37-50.
- (1965): *Taxionomische Revision und Nomenklatur zu Franz E. Hecht "Standard-Gliederung der Nordwest-deutschen Unterkreide nach Foraminiferen" (1938). Teil 4: Alb. Mit Beschreibungen von Arten aus verschiedenen Unterkreide-Niveaus*. - Senckenb. Lethaea 46/4-6, 327-366.
- (1974): *Lenticulina (Lenticulina) nodosa (Reuss 1863) and its subspecies - worldwide index foraminifera in the Lower Cretaceous*. - Eclogae geol. Helv. 67/3, 539-562.
- (1977): *Stratigraphic parallelisation of the Lower Cretaceous in the northern hemisphere*. - Newsl. Stratigr. 6/1, 30-41.
- (1979): *Worldwide zonation of the Lower Cretaceous using benthonic foraminifera*. - Newsl. Stratigr. 7/3, 142-154.
- (1981): *Additional observations on Textularia bettenstaedti Bartenstein & Oertli 1977, and Falsogaudryinella Bartenstein 1977 (Foraminifera)*. - N. Jb. Geol. Paläont. [Abh.] 161/3, 309-323.
- BARTENSTEIN, H., & BETTENSTAEDT, F. (1962): *Marine Unterkreide (Boreal und Tethys)*. In: *Leitfossilien der Mikropaläontologie* (B7, p. 225-297). - Borntraeger, Berlin.
- BARTENSTEIN, H., BETTENSTAEDT, F., & BOLLI, H. M. (1957): *Die Foraminiferen der Unterkreide von Trinidad, B.W.I. Erster Teil: Cuche- und Toco-Formation*. - Eclogae geol. Helv. 50/1, 5-67.



- (1966): *Die Foraminiferen der Unterkreide von Trinidad, W.I. Zweiter Teil: Maridale-Formation (Typlokalität)*. – *Eclogae geol. Helv.* 59/1, 129–177.
- BARTENSTEIN, H., BETTENSTAEDT, F., & KOVATCHEVA, T. (1971): *Foraminiferen des bulgarischen Barrême. Ein Beitrag zur weltweiten Unterkreide-Stratigraphie*. – *N. Jb. Geol. Paläont. [Abh.]* 139/2, 125–162.
- BARTENSTEIN, H., & BOLLI, H.M. (1973): *Die Foraminiferen der Unterkreide von Trinidad, W.I. Dritter Teil: Maridaleformation (Co-Typlokalität)*. – *Eclogae geol. Helv.* 66/2, 389–418.
- (1977): *The Foraminifera in the Lower Cretaceous of Trinidad, W.I. Part 4: Cuche Formation, upper Part; Leupoldina protuberans-Zone*. – *Eclogae geol. Helv.* 70/2, 543–573.
- BARTENSTEIN, H., & BRAND, E. (1951): *Mikropaläontologische Untersuchungen zur Stratigraphie des nordwestdeutschen Valendis*. – *Abh. senckenb. natf. Ges.* 485, 239–336.
- BARTENSTEIN, H., & KOVATCHEVA, T. (1970): *Foraminiferen-Korrelation des bulgarisch-NW deutschen Barrême im Rahmen einer weltweiten Kreidestratigraphie*. – *Rev. bulgar. geol. Soc.* 31/2, 159–165.
- BETTENSTAEDT, F., & WICHER, C.A. (1955): *Stratigraphic correlation of Upper Cretaceous and Lower Cretaceous in the Tethys and Boreal by the aid of microfossils*. – *Proc. IV World Petrol. Congr. Sect. I/ D*, 493–516.
- BOLLI, H.M., LOEBLICH, A.R., & TAPPAN, H. (1957): *Planktonic foraminiferal families Hantkeninidae, Orbulinidae, Globorotaliidae and Globotruncanidae*. – *Bull. U.S. natl. Mus.* 215, 3–50.
- COSTEA, J. (1974): *Micropaleontological study of the Lower Cretaceous in the central part of the Moesian Platform (Romania)*. – *N. Jb. Geol. Paläont. [Abh.]* 146/1, 1–28.
- DIENI, I., & MASSARI, F. (1966): *I Foraminiferi del Valanginiano superiore di Orosei (Sardegna)*. – *Palaeontographia ital.* 61 [n.s. 31], 75–186.
- FLETCHER, B.N. (1973): *The Distribution of Lower Cretaceous (Berriasian-Barremian) Foraminifera in the Speeton Clay*. In: *The Boreal Lower Cretaceous*. – *Spec. issue Geol. J. (Liverpool)* 5, 161–168.
- FRANKE, A. (1928): *Die Foraminiferen der Oberen Kreide Nord- und Mitteldeutschlands*. – *Abh. preuss. geol. Landesanst. [N.F.]* 111, 1–208.
- FRIEG, C. (1980): *Neue Ergebnisse zur Systematik sandschaliger Foraminiferen im Cenoman des südwestlichen Münsterlandes*. – *Paläont. Z.* 54/3–4, 225–240.
- FRIZZELL, D.L. (1954): *Handbook of Cretaceous Foraminifera of Texas*. – *Rep. Invest. Bur. econ. Geol. Univ. Texas* 22, 1–232.
- GORBACHIK, T.N., & SCHOKHINA, W.A. (1960): *Foraminiferi*. In: *Atlas niznemelovoi fauny Severnogo Kavkaza i Kryma*. – *Trudy V.N.I.I. Gasov*, 77–124.
- GRADSTEIN, F.M. (1978): *Biostratigraphy of Lower Cretaceous Blake Nose and Blake-Bahama Basin Foraminifers DSDP Leg 44, western North Atlantic Ocean*. – *Init. Rep. Deep Sea Drill. Proj.* 44, 663–701.
- HOFKER, L. (1960): *The taxonomic status of Praeglobotruncana, Planomalina, Globigerinella and Biglobigerinella*. – *Micropaleontology* 6/3, 315–322.
- JOVCHEVA, P.M. (1962): *Foraminifera from the Oolitic Limestone of the Aptian along the Rusenski Lom River*. – *Rev. bulgar. geol. Soc.* 23/1, 41–61.
- (1965): *Le Crétacé inférieur*. In: *Les associations microfossiles en Bulgarie*. – *Dir. gén. Géol. Inst. sci. Rech. géol. (Sofia)*, p. 53–60.
- (1966): *On the stratigraphic occurrence of the Genus Pleurostomella in the Lower Cretaceous in Bulgaria*. – *Rev. bulgar. geol. Soc.* 27/2, 207–210.
- JOVCHEVA, P.M., & TRIFONOVA, E. (1960): *Microfauna of the Tithonian-Valanginian in North-West Bulgaria*. – *Ann. Dir. gén. Rech. géol. (Sofia)* 11, 161–195.
- KOVATCHEVA, T. (1968): *Barremian and Aptian Foraminifera near Malka-Gelezna and Bulgarski-Izvor Villages (District of Lovetch)*. – *Bull. geol. Inst. [Ser. Paleont.] (Sofia)* 17, 5–35.
- (1969): *On the Age of the Urganian Sediments in the Lovetch Area based on their Foraminiferal Content*. – *Bull. geol. Inst. [Ser. Paleont.] (Sofia)* 18, 25–46.
- (1975): *Foraminifera from the Aptian Stage in the Fore-Balkan and the Northeastern Part of the Moesian Platform. 1. The Bedoulian Substage in the Northeastern Part of the Moesian Platform*. – *Palaeont. Stratigr. Lithol. (Sofia)* 2, 35–47.
- (1976a): *Foraminifera from the Aptian Stage in the Fore-Balkan and the Northeastern Part of the Moesian Platform. 2. Gargasian Substage in the Northeastern Part of the Moesian Platform*. – *Palaeont. Stratigr. Lithol. (Sofia)* 4, 27–36.
- (1976b): *Zonation of the Barremian and the Aptian from the Fore-Balkan and the Northeastern Part of the Moesian Platform on Foraminifera*. – *Geologica balkan.* 6/3, 81–92.

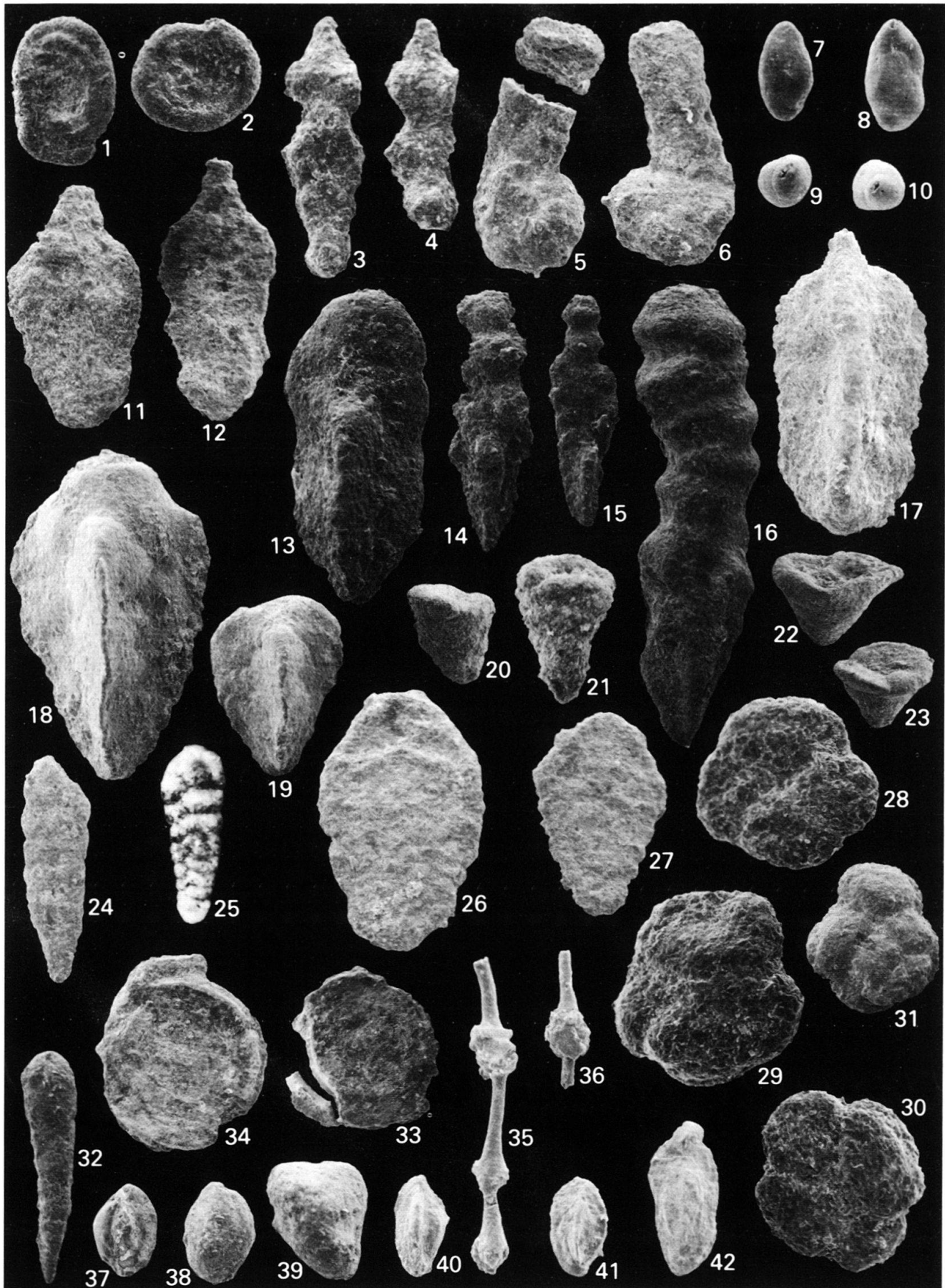
- (1977): *Foraminifera from the Aptian Stage in the Fore-Balkan and the Northeastern Part of the Moesian Platform. 3. The Clansayesian Substage in the Northeastern Part of the Moesian Platform.* – Palaeont. Stratigr. Lithol. (Sofia) 7, 35–44.
- (1979a): *Foraminifera from the Aptian Stage in the Fore-Balkan and the Northeastern Part of the Moesian Platform. 4. The Bedoulian Substage in the Fore-Balkan.* – Palaeont. Stratigr. Lithol. (Sofia) 10, 11–28.
- (1979b): *Foraminiferen der Urgon-Ablagerungen in Bulgarien und ihr stratigraphischer Wert.* – Mém. spéc. Geobios 3, 183–191.
- KUHRY, B. (1971): *Lower Cretaceous Planktonic Foraminifera from the Miravetes, Argos and Represa Formations (N.E. Iran).* – Rev. españ. Micropaleont. 3/3, 219–237.
- LOEBLICH, A.R., & TAPPAN, H. (1949): *Foraminifera from the Walnut Formation (Lower Cretaceous) of northern Texas and southern Oklahoma.* – J. Paleont. 23/3, 245–266.
- LUTERBACHER, H. (1975): *Early Cretaceous Foraminifera from the northwestern Pacific: Leg 32 of the Deep Sea Drilling Project.* – Init. Rep. Deep Sea Drill. Proj. 32, 703–718.
- MICHAEL, E. (1967): *Die Mikrofauna des nordwestdeutschen Barrême. Teil I: Die Foraminiferen des nordwestdeutschen Barrême.* – Palaeontographica, Suppl.-Bd. 12, 1–176.
- MOULLADE, M. (1966): *Etude stratigraphique et micropaléontologique du Crétacé inférieur de la “Fosse vocontienne”.* – Doc. Lab. Géol. Fac. Sci. Lyon 15, 1–369.
- NIKOLOV, T. (1965): *Etages, sous-étages et zones d’Ammonites du Crétacé inférieur en Bulgarie du Nord.* – Collège Crétacé inférieur (Lyon 1963), Mém. Bur. Rech. géol. min. 34, 803–817.
- (1969): *Stratigraphy of the Lower Cretaceous on a part of North-Eastern Bulgaria.* – Bull. geol. Inst. [Ser. Stratigr. Lithol.] (Sofia) 18, 31–71.
- NIKOLOV, T., & KHRISCHEV, KH. (1965): *Principles of the Stratigraphy and Lithology of the Lower Cretaceous in the Fore-Balkan.* – Trav. Géol. Bulgarie [Sér. Stratigr. Tect.] 6, 77–175.
- OHM, U. (1967): *Zur Kenntnis der Gattungen Reinholdella, Garantella und Epistomina (Foramin.).* – Palaeontographica (A) 127, 1–188.
- RICHTER, R. (1948): *Einführung in die Zoologische Nomenklatur durch Erläuterung der Internationalen Regeln* (2nd ed., p. 1–252). – Kramer, Frankfurt am Main.
- SIGAL, J. (1979): *Chronostratigraphy and Ecostratigraphy of Cretaceous Formations recovered on DSDP Leg 47B, Site 398.* – Init. Rep. Deep Sea Drill. Proj. 47/2, 287–326.
- SLITER, W.V. (1976): *Cretaceous Foraminifers from the southwestern Atlantic Ocean, Leg 36, Deep Sea Drilling Project.* – Init. Rep. Deep Sea Drill. Proj. 36, 519–573.
- STANCHEVA, M. (1959): *Lenticulina and Robulus of the Cretaceous and Tertiary in North-Eastern Bulgaria.* – Trav. Géol. Bulgarie [Sér. Paléont.] 1, 115–227.
- VAPZAROVA, J. (1956): *Formes fossiles des Verneuilinidae dans le Crétacé et le Tertiaire du Nord-Est de la Bulgarie.* – Ann. Dir. gén. Rech. géol. (Sofia) 7, 37–69.

## Plates 1–5

Scanning electron micrographs executed in the Scanning Laboratory of the Elf-Aquitaine Research Center at F-64018 Pau. – The material shown in the figures is available at the “Naturhistorisches Museum, Basel”, No. C35296–C35465. The Bulgarian localities have always the same kind of citation: (e.g.) Kozar Belene (Pleven) means Section near Village Kozar Belene in the District Pleven. – L = length in mm; D = diameter in mm; W = width in mm.

**Plate 1**All Figures about  $\times 40$ .

- Fig. 1-2 *Ammodiscus gaultinus* BERTHELIN 1880. Bedoulian. Bjala reka (Veliko Tarnovo). D: 0.6 (1: C 35296); 0.5 (2: C 35297).
- Fig. 3-4 *Reophax scorpiurus* MONTFORT 1808. Bedoulian. Kovacevec (Targoviste). L: 1.0 (3: C 35298); 0.83 (4: C 35299).
- Fig. 5-6 *Pseudocyclamina* aff. *cylindrica* REDMOND 1964. Bedoulian. Presjaka (Lovec). L: 1.0 (5: C 35300); 0.95 (6: C 35301). W: 0.34 (5); 0.3 (6). 5: Broken specimen.
- Fig. 7-10 *Falsogaudryinella moesiana* (NEAGU 1965). Clansayesian. Kozar Belene (Pleven). L: 0.4 (7: C 35302); 0.43 (8: C 35303). D: 0.22 (9-10: C 35304, C 35305).
- Fig. 11-12 *Flabellamina bulgarica* n.sp. Bedoulian. Asenovo (Veliko Tarnovo). 11: Holotype. L: 0.95; W: 0.55. C 35306. 12: Paratype. L: 1.03; W: 0.48. C 35307.
- Fig. 13 *Gaudryina borimensis* KOVATCHEVA 1969. Bedoulian. Asenovo (Veliko Tarnovo). L: 1.25. C 35308.
- Fig. 14-15 *Gaudryina praedividens* NEAGU 1975. Bedoulian. 14: Bojka (Ruse). L: 1.02. C 35309. 15: Kovacevec (Targoviste). L: 0.92. C 35310.
- Fig. 16 *Gaudryina reicheli* BARTENSTEIN, BETTENSTAEDT & BOLLI 1966. Clansayesian. Sumer (Mihailovgrad). L: 1.8. C 35311.
- Fig. 17 *Triplasia georgsdorfensis* (BARTENSTEIN & BRAND 1949). Bedoulian. Bojka (Ruse). L: 1.2; W: 0.6. C 35312.
- Fig. 18-19 *Tritaxia pyramidata* REUSS 1863. Bedoulian. Bjala reka (Veliko Tarnovo). L: 1.3 (18: C 35313); 0.73 (19: C 35314). W: 0.8 (18); 0.53 (19).
- Fig. 20-21 *Marssonella praeoxycona* (MOULLADE 1966). Bedoulian. Asenovo (Veliko Tarnovo). L: 0.4 (20: C 35315); 0.52 (21: C 35316).
- Fig. 22-23 *Marssonella subtrochus* BARTENSTEIN 1962. Clansayesian. Kozar Belene (Pleven). L: 0.4 (22: C 35317); 0.3 (23: C 35318). W: 0.47 (22); 0.38 (23).
- Fig. 24-25 *Textularia bettenstaedti* BARTENSTEIN & OERTLI 1977. 24: C 35319. Bedoulian. Asenovo (Veliko Tarnovo). L: 0.9; W: 0.27. The particular character of the SEM photographs means that no of the typical "coal dust" crystals can be observed. 25: Lower Albian. Altwarmbuechen, North West Germany. L: 0.7. Published in BARTENSTEIN & OERTLI (1977), N. Jb. Geol. Paläont. [Mh.] 1, p.15-24, Fig.4.2: Normal photograph showing the typical "coal dust" crystals at the lower edge of the chambers and in the sutures.
- Fig. 26-27 *Flabellamina urgonensis* n.sp. Bedoulian, Urganian facies type. Koevci (Veliko Tarnovo). 26: Holotype. L: 1.7, W: 0.65. C 35320. 27: Paratype. L: 0.8. C 35321.
- Fig. 28-31 *Trochammia gerochi* n.sp. Bedoulian. 28-29: Bojka (Ruse). 30-31: Radanovo (Veliko Tarnovo). 28: Holotype. D: 0.65. C 35322. 29-31: Paratypes. D: 0.7 (29: C 35323); 0.6 (30: C 35324); 0.57 (31: C 35325).
- Fig. 32 *Pleurostomella reussi* BERTHELIN 1880. Clansayesian. Sumer (Mihailovgrad). L: 0.9. C 35326.
- Fig. 33-34 *Ophthalmidium gaultinum* (DAM 1950). Bedoulian. Presjaka (Lovec). D: 0.65 (33: C 35327); 0.78 (34: C 35328).
- Fig. 35-36 *Pseudonubeculina nodulosa* (CHAPMAN 1891). Clansayesian. Kozar Belene (Pleven). L: 1.26 (35: C 35329); 0.57 (36: C 35330; one chamber).
- Fig. 37-39 *Quinqueloculina pseudominima* n.sp. Bedoulian. Koevci (Veliko Tarnovo). 37: Holotype. L: 0.4, W: 0.28. C 35331. 38: Paratype. L: 0.42, W: 0.28. C 35332. 39: Paratype. W: 0.51. C 35333.
- Fig. 40-41 *Quinqueloculina scythica* NEAGU 1968. Clansayesian. Kozar Belene (Pleven). L: 0.4 (40: C 35334); 0.42 (41: C 35335). W: 0.23 (40); 0.22 (41).
- Fig. 42 *Quinqueloculina scythica* NEAGU 1968. Barremian. Type locality NEAGU (1968): Ostrov, southern Dobrogea. L: 0.62; W: 0.27. C 35336.

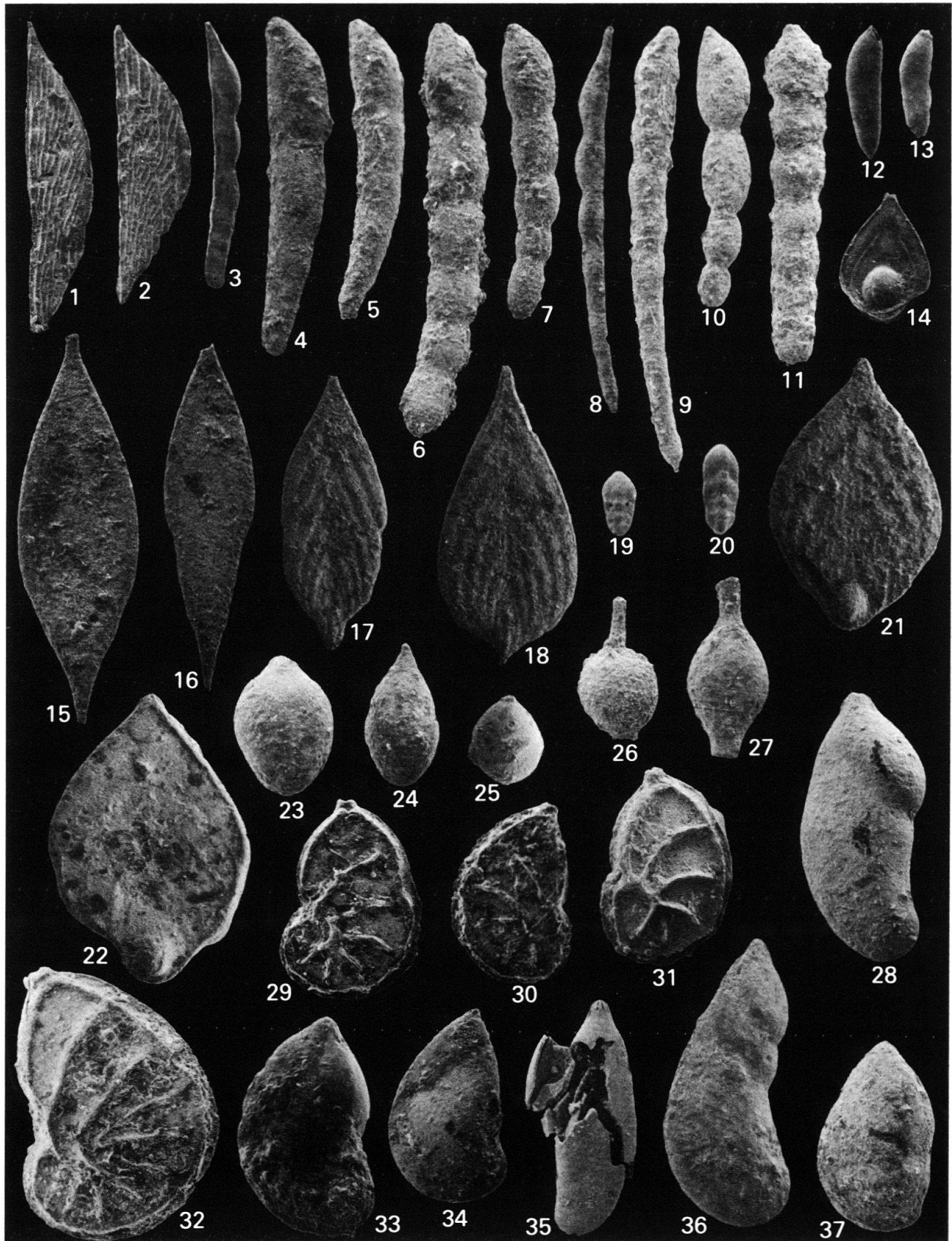




## Plate 2

All Figures about  $\times 40$ .

- Fig. 1-2 *Citharina acuminata* (REUSS 1863). Gargasian. Between Vetrliste and Vehtovo (Sumen). L: 1.2 (1: C 35337); 1.08 (2: C 35338).
- Fig. 3 *Dentalina debilis* (BERTHELIN 1880). Clansayesian. Kozar Belene (Pleven). L: 1.03 C 35339.
- Fig. 4-5 *Dentalina communis* D'ORBIGNY 1826. Asenovo (Veliko Tarnovo). L: 1.32 (4: C 35340); 1.15 (5: C 35341).
- Fig. 6-7 *Dentalina distincta* REUSS 1860. Bedoulian. Kovacevec (Targoviste). L: 1.6 (6: C 35342); 1.15 (7: C 35343).
- Fig. 8-9 *Dentalina gracilis* D'ORBIGNY 1839. Bedoulian. Kovacevec (Targoviste). L: 1.5 (8: C 35344); 1.75 (9: C 35345).
- Fig. 10 *Dentalina guttifera* D'ORBIGNY 1846. Bedoulian. Bojka (Ruse). L: 1.1. C 35346.
- Fig. 11 *Dentalina linearis* (ROEMER 1841). Bedoulian. Palamarca (Targoviste). L: 1.3. C 35347.
- Fig. 12-13 *Dentalina nana* REUSS 1863. Clansayesian. Kozar Belene (Pleven). L: 0.53 (12: C 35348); 0.42 (13: C 35349).
- Fig. 14 *Fronicularia filocincta* Reuss 1863. Gargasian. Sanidinovo (Pleven). L: 0.53. C 35350.
- Fig. 15-16 *Fronicularia hastata* ROEMER 1842. Bedoulian. Asenovo (Veliko Tarnovo). L: 1.52 (15: C 35351); 1.38 (16: C 35352).
- Fig. 17-18 *Fronicularia inversa* REUSS 1845. Bedoulian. Between Vetrliste and Vehtovo (Sumen). L: 1.08 (17: C 35353); 1.17 (18: C 35354).
- Fig. 19-20 *Fronicularia loryi* (BERTHELIN 1880). Clansayesian. Kozar Belene (Pleven). L: 0.27 (19: C 35355); 0.35 (20: C 35356).
- Fig. 21-22 *Fronicularia perovata* CHAPMAN 1894. Bedoulian. Bojka (Ruse). L: 1.07 (21: C 35357); 1.17 (22: C 35358). W: 0.62 (21); 0.73 (22).
- Fig. 23-25 *Lagena* aff. *apiculata* (REUSS 1851). Clansayesian. Sumer (Mihailovgrad). L: 0.53 (23: C 35359); 0.55 (24: C 35360); 0.35 (25: C 35361).
- Fig. 26 *Lagena* aff. *hauteriviana* BARTENSTEIN & BRAND 1951. Bedoulian. Between Vetrliste and Vehtovo (Sumen). L: 0.53. C 35362.
- Fig. 27 *Lagena* aff. *hauteriviana* BARTENSTEIN & BRAND 1951. Clansayesian. Sumer (Mihailovgrad). L: 0.7. C 35363.
- Fig. 28 *Lenticulina (Astacolus) calliopsis* (REUSS 1863). Bedoulian. Asenovo (Veliko Tarnovo). L: 1.0. C 35364.
- Fig. 29-32 *Lenticulina (Astacolus) crepidularis* (ROEMER 1842). Bedoulian. 29-30: Asenovo (Veliko Tarnovo). *crepidularis* types; L: 0.72 (29: C 35365); 0.65 (30: C 35366). 31-32: Boyka (Ruse). *tricarinnella* types; L: 0.75 (31: C 35367); 1.03 (32: C 35368).
- Fig. 33-34 *Lenticulina (Astacolus) planiuscula* (REUSS 1863). Bedoulian. Kovacevec (Targoviste). L: 1.0 (33: C 35369); L: 0.74 (34: C 35465).
- Fig. 35 *Lenticulina (Astacolus) schloenbachi* (REUSS 1863). Clansayesian. Kozar Belene (Pleven). L: 0.88 (Broken specimen). C 35370.
- Fig. 36-37 *Lenticulina (Astacolus) scitula* (BERTHELIN 1880). Bedoulian. Between Vetrliste and Vehtovo (Sumen). L: 1.07 (36: C 35371); 0.67 (37: C 35372).

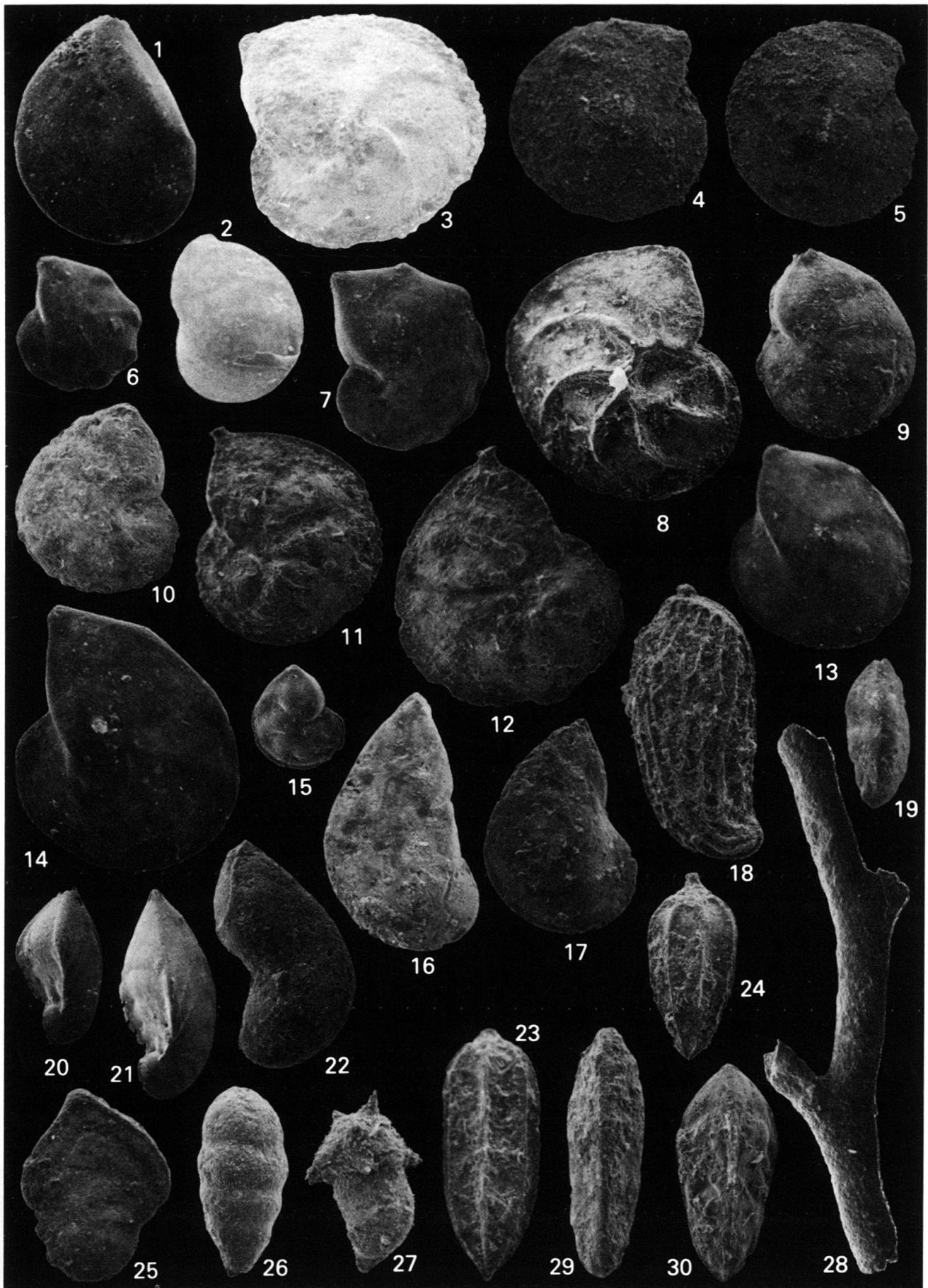




## Plate 3

All figures about  $\times 40$ .

- Fig. 1-2 *Lenticulina (Lenticulina) gaultina* (BERTHELIN 1880). 1: Clansayesian. Kozar Belene (Pleven). D: 0.82. C 35373. 2: Gargasian. Varana (Pleven). D: 0.62. C 35374.
- Fig. 3 *Lenticulina (Lenticulina) heiermanni* BETTENSTAEDT 1952. Bedoulian. Palamarca (Targoviste). D: 0.92. C 35375.
- Fig. 4-5 *Lenticulina (Lenticulina) muensteri* (ROEMER 1839). Bedoulian. Gorno Pavlikene (Lovec). D: 0.76 (4: C 35376); 0.74 (5: C 35377).
- Fig. 6-7 *Lenticulina (Lenticulina) nodosa* (REUSS 1863). 6: Gargasian. Varana (Pleven). D: 0.5. C 35378. 7: Clansayesian. Between Belcov and Cenovo (Ruse). D: 0.73. C 35379.
- Fig. 8 *Lenticulina (Lenticulina) ouachensis ouachensis* (SIGAL 1952). Bedoulian. Asenovo (Veliko Tarnovo). D: 1.02. C 35380.
- Fig. 9-10 *Lenticulina (Lenticulina) pulchella* (REUSS 1863). Gargasian. Bjala (Ruse). D: 0.75 (9: C 35381); 0.76 (10: C 35382).
- Fig. 11-12 *Lenticulina (Lenticulina) aff. saxocretacea* BARTENSTEIN 1954. Bedoulian. Opaka (Targoviste). D: 0.85 (11: C 35383); 0.95 (12: C 35384).
- Fig. 13-14 *Lenticulina (Lenticulina) secans* (REUSS 1860). Gargasian. Varana (Pleven). D: 0.77 (13: C 35385); 0.94 (14: C 35386).
- Fig. 15 *Lenticulina (Lenticulina) sternalis* (BERTHELIN 1880). Clansayesian. Kozar Belene (Pleven). D: 0.4, juvenile specimen. C 35387.
- Fig. 16-17 *Lenticulina (Lenticulina) subgaultina* BARTENSTEIN 1962. Clansayesian. Between Belcov and Cenovo (Ruse). D: 1.0 (16: C 35388); 0.78 (17: C 35389).
- Fig. 18 *Lenticulina (Marginulinopsis) djaffaensis* (SIGAL 1952). Bedoulian. Between Vetrliste and Vehtovo (Sumen). L: 1.02. C 35390.
- Fig. 19 *Lenticulina (Saracenaria) franki* (DAM 1946). Bedoulian. Asenovo (Veliko Tarnovo). L: 0.56, juvenile specimen. C 35464.
- Fig. 20-21 *Lenticulina (Saracenaria) spinosa* (EICHENBERG 1935). Gargasian. Varana (Pleven). L: 0.6 (20: C 35391); 0.8 (21: C 35392).
- Fig. 22 *Lenticulina (Vaginulinopsis) excentrica* (CORNUEL 1848). Bedoulian. Asenovo (Veliko Tarnovo). L: 0.875. C 35393.
- Fig. 23-24 *Nodosaria obscura* REUSS 1845. Bedoulian. Palamarca (Targoviste). L: 0.95 (23: C 35394); 0.7 (24: C 35395).
- Fig. 25 *Palmula aff. dentonensis* LOEBLICH & TAPPAN 1941. Clansayesian. Sumer (Mihailovgrad). L: 0.7, only coiled portion and two chambers of the uncoiled portion. C 35396.
- Fig. 26 *Pseudonodosaria mutabilis* (REUSS 1863). Bedoulian. Asenovo (Veliko Tarnovo). L: 0.7. C 35397.
- Fig. 27 *Pyrulina infracretacea* BARTENSTEIN 1952. Bedoulian. Opaka (Targoviste). L: 0.7, fistulose growth. C 35398.
- Fig. 28 *Ramulina aculeata* WRIGHT 1889. Gargasian. Varana (Pleven). L: 2.08. C 35399.
- Fig. 29-30 *Tristix acutangula* (REUSS 1863). Bedoulian. Between Vetrliste and Vehtovo (Sumen). L: 0.94 (29: C 35400); 0.8 (30: C 35401).



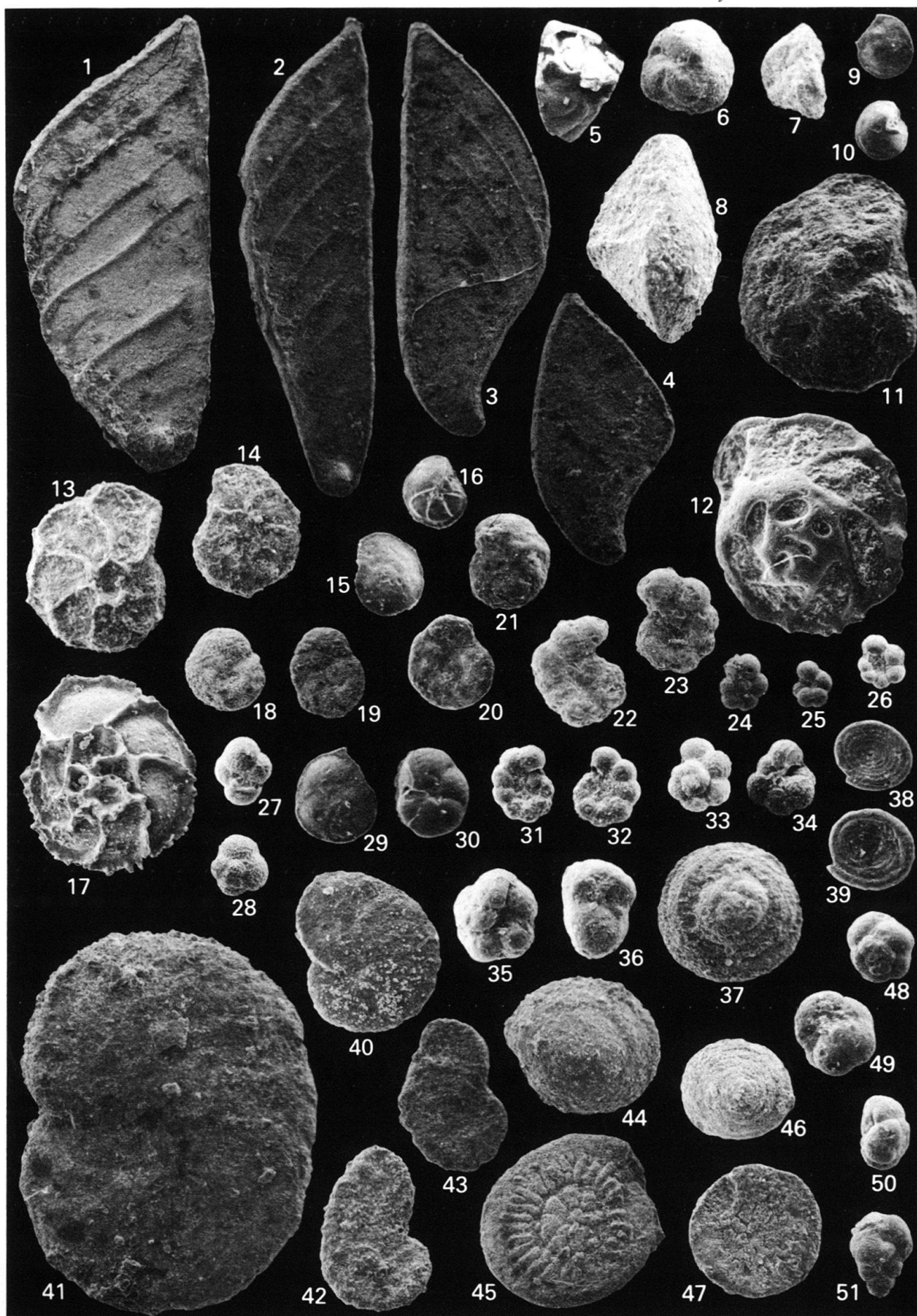
## Plate 4

664

All Figures about  $\times 40$ .

- Fig. 1-2 *Vaginulina arguta* REUSS 1860. Bedoulian. Asenovo (Veliko Tarnovo). L: 1.8, *trunca* type (1: C 35402); 1.9, *arguta* type (2: C 35403).
- Fig. 3-4 *Vaginulina kochi* ROEMER 1841. Bedoulian. Asenovo (Veliko Tarnovo). L: 1.62 (3: C 35404); 1.0 (4: C 35405).
- Fig. 5 *Conorotalites aptiensis* (BETTENSTAEDT 1952). Gargasian. Varana (Pleven). D: 0.47, broken specimen, apertural view. C 35406.
- Fig. 6-7 *Conorotalites intercedens* (BETTENSTAEDT 1952). Bedoulian. Opaka (Targoviste). D: 0.38, umbilical side (6: C 35407); 0.4, apertural view (7: C 35408).
- Fig. 8 *Epistomina caracolla* (ROEMER 1841). Bedoulian. Asenovo (Veliko Tarnovo). D: 0.81, corroded specimen, apertural view. C 35409.
- Fig. 9-10 *Epistomina chapmani* DAM 1948. Clansayesian. Kozar Belene (Pleven). D: 0.26 (both), spiral and umbilical side. Juvenile specimens. 9: C 35410; 10: C 35411.
- Fig. 11-12 *Epistomina colomi* DUBOURDIEU & SIGAL 1949. Gargasian. Varana (Pleven). D: 0.87, umbilical side (11: C 35412); 0.95, spiral side (12: C 35413).
- Fig. 13-14 *Epistomina cretosa* DAM 1947. Gargasian. Goran (Lovec). D: 0.68, umbilical side (13: C 35414); 0.54, spiral side (14: C 35415).
- Fig. 15-16 *Epistomina reticulata* (REUSS 1863). Clansayesian. Butovo (Veliko Tarnovo). D: 0.35, spiral side (15: C 35416); 0.28, umbilical side (16: C 35417). Juvenile specimens (REUSS' original specimen D: 0.58).
- Fig. 17 *Epistomina spinulifera* (REUSS 1863). Clansayesian. Kozar Belene (Pleven). D: 0.83, spiral side. C 35418.
- Fig. 18-19 *Gavelinella barremiana* BETTENSTAEDT 1952. Bedoulian. Bojka (Ruse). 18: D: 0.35, umbilical side with sinistrality of chambers. C 35419. 19: D: 0.39, spiral side with dextrality of chambers. C 35420.
- Fig. 20-21 *Gavelinella intermedia* (BERTHELIN 1880). Clansayesian. Borovo (Ruse). D: 0.38, spiral side (20: C 35421); 0.39, umbilical side (21: C 35422).
- Fig. 22-23 *Globigerinelloides algerianus* CUSHMAN & DAM 1948. Clansayesian. Borovo (Ruse). D: 0.45 (both), spiral and umbilical side. 22: C 35423; 23: C 35424.
- Fig. 24-25 *Hedbergella infracretacea* (GLAESSNER 1937). Clansayesian. Kozar Belene (Pleven). 24: D: 0.23, spiral side with sinistrality of chambers. C 35425. 25: D: 0.2, umbilical side with dextrality of chambers. C 35426.
- Fig. 26 *Hedbergella planispira* (TAPPAN 1940). Clansayesian. Kozar Belene (Pleven). D: 0.22, umbilical side. C 35427.
- Fig. 27-28 *Hedbergella tardita* (ANTONOVA 1964). Clansayesian. Butovo (Veliko Tarnovo). D: 0.27 (27: C 35428); 0.25 (28: C 35429), umbilical and spiral side.
- Fig. 29-30 *Lamarckina lamplughii* (SHERLOCK 1914). Clansayesian. Kozar Belene (Pleven). 29: D: 0.38, spiral side, last formed chamber broken. C 35430. 30: D: 0.37, umbilical side, last formed chamber broken. C 35431.
- Fig. 31-32 *Planomalina caseyi* BOLLI, LOEBLICH & TAPPAN 1957. Clansayesian. Kozar Belene (Pleven). D: 0.31 (31: C 35432); 0.33 (32: C 35433).
- Fig. 33-34 *Ticinella roberti* (GANDOLFI 1942). Clansayesian. Butovo (Veliko Tarnovo). D: 0.29, spiral side (33: C 35434); 0.31, umbilical side (34: C 35435).
- Fig. 35-36 *Valvulineria loetterlei* (TAPPAN 1940). Clansayesian. Sumer (Mihailovgrad). D: 0.4, umbilical side (35: C 35436); 0.4, apertural view (36: C 35437).
- Fig. 37 *Patellina subcretacea* CUSHMAN & ALEXANDER 1930. Bedoulian. Between Vetrliste and Vehtovo (Sumen). D: 0.57, spiral side. C 35438.
- Fig. 38-39 *Spirillina minima* SCHACKO 1892. Clansayesian. Kozar Belene (Pleven). D: 0.32 (38: C 35439); 0.35 (39: C 35440).
- Species restricted to the Urgonian and para-Urgonian:
- Fig. 40-41 *Choffatella decipiens* SCHLUMBERGER 1905. Bedoulian. Presjaka (Lovec). D: 0.7, juvenile specimen (40: C 35441); 1.5, adult specimen (41: C 35442).
- Fig. 42-43 *Ammomarginulina lorica* LOEBLICH & TAPPAN 1949. Bedoulian. Sokolovo (Lovec). D: 0.7 (42: C 35443); 0.67 (43: C 35444).
- Fig. 44-45 *Trocholina aptiensis* JOVACHEVA 1962. Bedoulian. Presjaka (Lovec). D: 0.62, spiral side (44: C 35445); 0.75, umbilical side (45: C 35446).
- Fig. 46-47 *Trocholina infragranulata* NOTH 1951. Bedoulian. Presjaka (Lovec). D: 0.46, spiral side (46: C 35447); 0.55, umbilical side (47: C 35448).
- Fig. 48-50 *Arenobulimina meltae* KOVATCHEVA 1969. Bedoulian. Koevci (Veliko Tarnovo). 48: D: 0.3, spiral side with sinistrality of chambers. C 35449. 49: D: 0.35, umbilical side with dextrality of chambers. C 35450. 50: D: 0.28, front view. C 35451.





### Plate 5

Fig. 1-11 about  $\times 40$ , Fig. 12-47 about  $\times 60$ .

Species restricted to the Urgonian and para-Urgonian:

- Fig. 1-2 *Citharina intumescens* (REUSS 1863). Bedoulian. Presjaka (Lovec). L: 1.12 (1: C 35453); 0.93 (2: C 35454).
- Fig. 3-4 *Lenticulina (Lenticulina) praegaultina* BARTENSTEIN, BETTENSTAEDT & BOLLI 1957. Bedoulian. Gorno Pavlikene (Lovec). D: 0.73 (3: C 35455); 0.62 (4: C 35456).
- Fig. 5-6 *Bolivina textilarioides* REUSS 1863. Bedoulian. Koevci (Veliko Tarnovo). L: 0.78 (5: C 35457); 0.55 (6: C 35458).
- Fig. 7-8 *Ammobaculites torosus* LOEBLICH & TAPPAN 1949. Bedoulian. Koevci (Veliko Tarnovo). L: 0.7, short megaspheric specimen (7: C 35459); 1.2, elongate microspheric specimen (8: C 35460).
- Fig. 9-10 *Palorbitolina lenticularis* (BLUMENBACH 1805). Bedoulian. Sokolovo (Lovec). D: 0.7 (9: C 35461); 0.73 (10: C 35462).
- Fig. 11 *Ammobaculoides carpathicus* GEROCH 1966. Bedoulian. Koevci (Veliko Tarnovo). L: 0.83. C 35463.

Other specimens with different enlargements ( $\times 60$ ):

- Fig. 12-15 *Falsogaudryinella moesiana* (NEAGU 1976). Clansayesian. Same Figures as Pl. 1, Fig. 7-10.
- Fig. 16 *Marssonella praeoxycona* (MOULLADE 1966). Bedoulian. Same Figure as Pl. 1, Fig. 20.
- Fig. 17-18 *Marssonella subtrochus* BARTENSTEIN 1962. Clansayesian. Same Figures as Pl. 1, Fig. 22-23.
- Fig. 19-20 *Frondicularia loryi* (BERTHELIN 1880). Clansayesian. Same Figures as Pl. 2, Fig. 19-20.
- Fig. 21 *Lagena* aff. *apiculata* (REUSS 1851). Clansayesian. Same Figure as Pl. 2, Fig. 23.
- Fig. 22-23 *Epistomina chapmani* DAM 1948. Clansayesian. Same Figures as Pl. 4, Fig. 9-10.
- Fig. 24-25 *Epistomina reticulata* (REUSS 1863). Clansayesian. Same Figures as Pl. 4, Fig. 15-16.
- Fig. 26-27 *Hedbergella infracretacea* (GLAESSNER 1937). Clansayesian. Same Figures as Pl. 4, Fig. 24-25.
- Fig. 28 *Hedbergella planispira* (TAPPAN 1940). Clansayesian. Same Figure as Pl. 4, Fig. 26.
- Fig. 29 *Globigerinelloides algerianus* CUSHMAN & DAM 1948. Clansayesian. Same Figure as Pl. 4, Fig. 23.
- Fig. 30-31 *Lamarckina lamplughii* (SHERLOCK 1914). Clansayesian. Same Figures as Pl. 4, Fig. 29-30.
- Fig. 32 *Epistomina cretosa* DAM 1947. Gargasian. Same Figure as Pl. 4, Fig. 14.
- Fig. 33-34 *Planomalina caseyi* BOLLI, LOEBLICH & TAPPAN 1957. Clansayesian. Same Figures as Pl. 4, Fig. 31-32.
- Fig. 35-36 *Ticinella roberti* (GANDOLFI 1942). Clansayesian. Same Figures as Pl. 4, Fig. 33-34.
- Fig. 37 *Verneuilinoides schizeus* (CUSHMAN & ALEXANDER 1930). Bedoulian. Same Figure as Pl. 4, Fig. 51.
- Fig. 38-39 *Hedbergella tardita* (ANTONOVA 1964). Clansayesian. Same Figures as Pl. 4, Fig. 27-28.
- Fig. 40-42 *Arenobulimina meltae* KOVATCHEVA 1969. Bedoulian. Same Figures as Pl. 4, Fig. 48-50.
- Fig. 43-44 *Spirillina minima* SCHACKO 1892. Clansayesian. Same Figures as Pl. 4, Fig. 38-39.
- Fig. 45-46 *Valvulineria loetterlei* (TAPPAN 1940). Clansayesian. Same Figures as Pl. 4, Fig. 35-36.
- Fig. 47 *Ammomarginulina loricata* LOEBLICH & TAPPAN 1949. Bedoulian. Same Figure as Pl. 4, Fig. 42.

