

## MIDWAY-TYPE BENTHIC FORAMINIFERA FROM THE PALEOCENE OF THE COASTAL PART OF EAST STARA PLANINA (EASTERN BULGARIA). FAMILY TEXTULARIIDAE EHRENBERG, 1838 TO FAMILY STILOSTOMELLIDAE FINLAY, 1947

**Boris Valchev**

University of Mining and Geology "St. Ivan Rilski", Sofia 1700; b\_valchev@mgu.bg

**ABSTRACT.** Taxonomical descriptions of 15 species Midway-type benthic foraminifera are introduced in the article. The species belong to 11 genera (*Textularia* – 2 species, *Dentalina* – 1 species, *Pyramidulina* – 1 species, *Bolivina* – 1 species, *Bulimina* – 2 species, *Globobulimina* – 1 species, *Praeglobobulimina* – 1 species, *Fursenkoina* – 1 species, *Nodogenerina* – 1 species, *Orthomorphina* – 1 species, *Siphonodosaria* – 3 species), 6 families, 6 superfamilies and 3 suborders. 13 species are first described in Bulgaria, 4 species are first found in Paleocene, and 1 species is first described from the Paleocene of Bulgaria.

The Loeblich & Tappan's (1988) classification is applied in the article.

*Key words:* taxonomy, "Midway-type" benthic foraminifera, Paleocene, East Stara Planina.

## БЕНТОСНИ ФОРАМИНИФЕРИ ТИП "MIDWAY" ОТ ПАЛЕОЦЕНСКАТА СЕРИЯ В ПРИМОРСКАТА ЧАСТ НА ИЗТОЧНА СТАРА ПЛАНИНА (ИЗТОЧНА БЪЛГАРИЯ). СЕМЕЙСТВО TEXTULARIIDAE EHRENBERG, 1838 ДО СЕМЕЙСТВО STILOSTOMELLIDAE FINLAY, 1947

**Борис Вълчев**

Минно-геоложки университет "Св. Иван Рилски", София 1700; b\_valchev@mgu.bg

**РЕЗЮМЕ.** Настоящата статия представя таксономични описания на 15 вида бентосни фораминифери тип "Midway". Те принадлежат на 11 рода (*Textularia* – 2 вида, *Dentalina* – 1 вид, *Pyramidulina* – 1 вид, *Bolivina* – 1 вид, *Bulimina* – 2 вида, *Globobulimina* – 1 вид, *Praeglobobulimina* – 1 вид, *Fursenkoina* – 1 вид, *Nodogenerina* – 1 вид, *Orthomorphina* – 1 вид, *Siphonodosaria* – 3 вида), 6 семейства, 6 надсемейства and 3 подразреда. 13 вида се описват за първи път в България, 4 са намерени за първи път в палеоценски седименти, а 1 е установен за първи път в скалите на Палеоценската серия в България.

Използвана е систематиката на Loeblich & Tappan (1988).

*Ключови думи:* таксономия, бентосни фораминифери тип "Midway", Палеоценска серия, Източна Стара планина.

### Introduction

The Paleocene of the Coastal part of East Stara Planina (East Bulgaria) contains characteristic elements of three types of benthic foraminiferal assemblages – flysh-type or A-type, Midway-type and Velasco-type (Valchev, 2004a). The present article is the first one from a series of three parts concerning the taxonomy of the Midway-type assemblages from this part of the country.

A sketch with the location of the studied sections and outcrops was published by Valchev (2003). The biostratigraphical framework of the Paleocene in the coastal part of East Stara Planina was discussed in the same article. The microphotographs were made in the Central Laboratory of Mineralogy and Crystallography of the Bulgarian Academy of Sciences by scanning electron microscope "Philips SEM-515" ( $U_{op} = 25$  kV).

### General remarks

"Midway-type" faunal assemblages (MF) are a middle to outer shelf assemblages (50-200 m water depth) developed in a shale-marl environment and characterized by various

representatives of the families Textulariidae, Nodosariidae, Vaginulinidae, Polymorphinidae, Alabaminidae, Heterolepidae. The assemblages were named the "Midway-type" because they have been described and illustrated repeatedly in the rocks of the Midway Group (Gulf Coastal Plain) and equivalent rocks in the Atlantic Coastal Plain of the USA and circum-Caribbean and Antillean region (Cushman, 1951; Olson, 1960; Berggren, 1972, 1974). They have been established in some other localities of the Tethyan region (e. g. Ukraine – Vassilenko, 1950; Kaptarenko-Chernousova et al., 1963; Krayeva, Zernetskij, 1969; Poland – Pozaryska, 1965; Pozaryska, Szczuchura, 1968; Caucasus – Subbotina, 1947, 1950; Sweden – Brotzen, 1948; the Netherlands - ten Dam, 1944; Australia – McGowran, 1965).

### Taxonomical descriptions

The present article aims to introduce taxonomical descriptions of 15 species small benthic foraminifera from the Paleocene of the Coastal Part of East Stara Planina, East Bulgaria. The species belong to 11 genera, 6 families, 6 superfamilies and 3 suborders. 13 species are first described

in Bulgaria, 4 species are first found in the Paleocene, and 1 species is first described from the Paleocene of Bulgaria.

Several taxonomical descriptions (See Appendix) of Midway-type benthics were given in previous Valchev's publications (Valchev, 2000, 2001, 2002, 2004b, c, 2005a, b).

The Loeblich & Tappan's (1988) classification is applied in the article.

Suborder TEXTULARIINA Delage and Herouard, 1896  
Superfamily TEXTULARIACEA Ehrenberg, 1838  
Family TEXTULARIIDAE Ehrenberg, 1838  
Subfamily TEXTULARIINAE Ehrenberg, 1838  
Genus *Textularia* DeFrance, 1824

*Type species. Textularia saggitula* DeFrance, in de Blainville, 1824 (original designation by monotypy).

*Distribution.* Paleocene - Holocene; cosmopolitan.

? *Textularia plummerae* Lalicker, 1935  
Plate I, Figures 1, 2

1937. *Textularia plummerae* Lalicker; Glaessner, S. 364.

1951. *Textularia plummerae* Lalicker; Cushman, p. 4, pl. 2, figs. 2, 3.

1960. *Textularia* cf. *plummerae* Lalicker; Geroch, p. 56, Tabl. 6, fig. 6.

1975. *Textularia plummerae* Lalicker; Braga et al., p. 91, T. 1, fig. 6.

*Nomenclature.* I have no data about the holotype.

*Material.* Byala Formation (199 specimens), Emine Formation (25 specimens).

*Description.* Test is elongated, coarsely agglutinated, biserial, with tapered initial part; gradually broadening towards the apertural end. Chambers are distinct, slightly inflated. Sutures are depressed, slightly curved backwards. Periphery is rounded. Aperture is basal.

*Remarks.* The species is morphologically similar to *S. navaroana* Cushman, but differs from it by the lack of spiral initial portion. When the initial part is broken both species are indistinct.

*Distribution.* The species is known from the Paleocene of Arkansas, Texas, Caucasus, the Alps, the Upper Paleocene of France, the Eocene of Caucasus and the Alps. It was found in the deep sea holes in the Labrador (Paleocene) and North Sea (Lower Eocene).

*Occurrence.* Byala Formation: C-11 (247.50 m – P1c Zone), C-12 (219.20 m – P1b Zone, 264.50 m – Lower Paleocene, 268.50-289.20 m – P1c Zone, 303.40 m – P1b Zone), C-21 (22.00-38.50 m – P1b Zone), C-23 (271.20 m – P1b Zone), C-24 (40.00 m – P2 Zone, 74.25 m – P1b Zone), C-25 (22.50-40.40 m – P1b Zone), C-28 (513.00 m – P3 Zone), C-29 (364.40-365.90 m – P3 Zone, 383.20-420.60 m – P4 Zone, 440.30-476.30 m – P5 Zone), C-30 (83.90-86.30 m – P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP3-5 Zone), Byala 2b (NP1-3 Zone), Byala 2c (NP1-2 Zone), Byala River and Koundilaki Cheshme valleys (Paleocene); Emine Formation: sections Emona (NP1 Zone) and Banya-Southwest (Paleocene).

*Textularia* sp.  
Plate I, Figure 3

*Material.* Byala Formation (1 specimen).

*Description.* Test is coarsely agglutinated, biserial, laterally flattened, sharply broadening towards the apertural end. It is

composed of 4 couples of chambers, as the chambers from the last one are strongly inflated.

*Occurrence.* C-25 (40.40 m – P1b Zone).

Suborder LAGENINA Delage and Herouard, 1896  
Superfamily NODOSARIACEA Ehreberg, 1838  
Family NODOSARIIDAE Ehreberg, 1838  
Subfamily NODOSARIINAE Ehreberg, 1838  
Genus *Dentalina* Riso, 1826

*Type species. Nodosaria* (les Dentalines) *cuvieri* d'Orbigny, 1826 (original designation by monotypy).

*Distribution.* Late Cretaceous - Holocene; cosmopolitan.

*Dentalina longicostata* (Cushman and Jarvis, 1934)  
Plate I, Figure 8

1934. *Chrysalogonium longicostatum* Cushman and Jarvis, n. sp.; Cushman, Jarvis, p. 74, pl. 10, fig. 12.

1949. *Chrysalogonium longicostatum* Cushman and Jarvis; Bermudez, p. 151, pl. 10, fig. 3.

1957. *Chrysalogonium longicostatum* Cushman and Jarvis; Agyp, pl. 14, fig. 8.

*Nomenclature.* The holotype (Cushman Coll. No. 21 441) is from the Lower Miocene of Trinidad (Cipero section).

*Material.* Byala Formation (21 specimens).

*Description.* Test is uniserial, elongated, slightly curved, and tapered at both ends, with parallel sides. Chambers are distinct, gradually increasing in size. Sutures are straight depressed, horizontal. Surface is covered by fine longitudinal ribs. Aperture is terminal, compound.

*Remarks.* The representatives of this species have been usually referred to genus *Chrysalogonium*. According to Loeblich, Tappan's (1988) classification it is characterized by straight, elongated and smooth test, while the specimens described and figured in the micropaleontological literature are with slightly curved test covered by fine longitudinal ribs – characteristic features of genus *Dentalina*. That is why in the present article these specimens are referred to it.

*Distribution.* The species is known from the Oligocene of Italy, Cuba, Trinidad, the Miocene of Italy, and Trinidad. It has been also established in the deep sea holes in the Northwest Atlantic (Eocene – Lower Miocene).

*Occurrence.* C-11 (191.60 m – P1c Zone), C-25 (40.40 m – P1b Zone), C-29 (440.30 m – P5 Zone), sections Byala 1 (NP3 Zone), Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

Genus *Pyramidulina* Fornasini, 1894

*Type species. Pyramidulina eptagona* Fornasini, 1894 = *Nautilus raphanus* Linne, 1758 (original designation by monotypy).

*Distribution.* Cretaceous - Holocene; cosmopolitan.

*Pyramidulina tenuicostata* (Cushman & Bermudez, 1936)  
Plate I, Figure 4

1936. *Chrysalogonium tenuicostatum* Cushman & Bermudez, n. sp.; Cushman, Bermudez, p. 27, pl. 5, figs. 3-5.

1949. *Chrysalogonium tenuicostatum* Cushman & Bermudez; Bermudez, p. 151, pl. 10, fig. 2.

1957. *Chrysalogonium tenuicostatum* Cushman & Bermudez; Agyp, pl. 14, fig. 10.

**Nomenclature.** The holotype (Cushman Coll. No. 23 094) is from the Middle Eocene of Cuba.

**Material.** Byala Formation (33 specimens).

**Description.** Test is elongated, straight, tapered in the initial part. Sides are parallel. Chambers gradually increasing in size. Sutures are straight, horizontal, slightly depressed. Surface is covered by coarse longitudinal ribs. Aperture is terminal, compound.

**Remarks.** The representatives of this species have been usually referred to genus *Chrysalogonium*, but the presence of coarse longitudinal ribs made me refer them to genus *Pyramidulina*. The species differs from *D. longicostata* (Cushman and Jarvis) by its straight test and coarsely ornamented surface.

**Distribution.** It is known from the Eocene of Alabama, Cuba, the Upper Eocene, Oligocene and Miocene of Italy, the Oligocene of Cuba, and Trinidad. It was also established in the deep sea holes in the Atlantic (Lower – Middle Eocene), Bay of Biscay (Upper Eocene – Lower Oligocene).

**Occurrence.** C-23 (271.20 m – P1b Zone), C-24 (56.90 m – P1c Zone), C-25 (P1b Zone), C-30 (107.90 m – P5 Zone), sections Byala 1 (NP3-5 Zone), Byala 2c (NP1-2 Zone), Byala River and Koundilaki Cheshme Valleys (Paleocene).

Suborder ROTALIINA Delage and Herouard, 1896  
Superfamily BOLIVINACEA Glaessner, 1937  
Family BOLIVINIDAE Glaessner, 1937  
Genus ***Bolivina*** d'Orbigny, 1839

**Type species.** *Bolivina plicata* d'Orbigny, 1839 (subsequent designation by Cushman, 1911);

**Distribution.** Late Cretaceous – Holocene; cosmopolitan.

***Bolivina midwayensis*** Cushman, 1936  
Plate I, Figure 5

1937. *Bolivina midwayensis* Cushman; Cushman, p. 45, pl. 6, figs. 11-13.

1962. *Loxostomum midwayensis* (Cushman); Hillebrandt, S. 88, Taf. 6, Fig. 18, 19.

1976. *Bolivina midwayensis* Cushman; Aubert, Berggren, p. 420, pl. 4, fig. 10.

1983. *Coriphostoma* cf. *midwayensis* (Cushman); Tjalsma, Lohman, p. 12, pl. 2, figs. 7, 8.

**Nomenclature.** I have no data about the holotype. The species was first described from the Paleocene of Texas.

**Material.** Byala Formation (47 specimens).

**Description.** Test is elongated, slightly tapered in the apertural end, biserial. Chambers are low, broad. Sutures are oblique, slightly depressed. Periphery is narrowly rounded. Surface is smooth. Aperture is low, loop-shaped, basal.

**Distribution.** The species is known from the Paleocene of the Tethys region. It was also established during the deep sea drilling in the Atlantic (Paleocene).

**Occurrence.** Sections Byala 2b (NP3 Zone), Byala 2c (NP1 Zone).

Superfamily BULIMINACEA Jones, 1875  
Family BULIMINIDAE Jones, 1875  
Genus ***Bulimina*** d'Orbigny, 1826

**Type species.** *Bulimina marginata* d'Orbigny, 1826 (subsequent designation by Cushman, 1911);

**Distribution.** Paleocene - Holocene; cosmopolitan.

***Bulimina midwayensis*** Cushman and Parker, 1936  
Plate I, Figure 9

1936. *Bulimina arkadelphiana* Cushman and Parker var. *midwayensis* Cushman and Parker, n. var.; Cushman and Parker, p. 42, pl. 7, figs. 9, 10.

1962. *Bulimina midwayensis* Cushman and Parker; Hillebrandt, S. 76, Taf. 5, Fig. 19.

1976. *Bulimina midwayensis* Cushman and Parker; Aubert, Berggren, p. 422, pl. 5, fig. 7.

1983. *Bulimina midwayensis* Cushman and Parker; Tjalsma, Lohman, p. 6, pl. 3, fig. 1.

**Nomenclature.** The holotype (Cushman Coll. No. 23136) is from the Eocene of Texas. (Midway Formation).

**Material.** Byala Formation (28 specimens).

**Description.** Test is triserial, tapered at the initial part, bearing a basal spine. The last 3 chambers are inflated, smooth, comprising 1/3 to 1/2 of test length. The previous ones are covered by fine ribs. Sutures are depressed, curved. Aperture is loop-shaped, with lip.

**Distribution.** The species is known from the Paleocene of North America, Sweden, Denmark, Austria, Slovakia, Egypt, Tunisia, and the Eocene of Texas. It was also established during the deep-sea drilling in the Atlantic (Paleocene).

**Occurrence.** C-24 (40.00 m – P2 Zone), C-28 (16.00 m – P2 Zone), C-29 (399.00-420.60 m – P4 Zone), C-30 (86.30 m – P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP3 Zone), Byala 2c (NP2 Zone), Byala River Valley (Paleocene).

***Bulimina paleocenica*** Brotzen, 1948  
Plate I, Figure 10

1948. *Bulimina (Reussella) paleocenica* n. sp.; Brotzen, p. 60, pl. 6, figs. 5, 6.

1958. *Bulimina paleocenica* Brotzen; Haynes, p. 74, pl. 16, fig. 17.

1965. *Bulimina paleocenica* Brotzen; Pozaryska, p. 98, pl. 15, fig. 4.

1969. *Reussella paleocenica* (Brotzen); Krayeva, Zernetskiy, p. 149, pl. 71, fig. 2.

1976. *Bulimina paleocenica* Brotzen; Aubert, Berggren, p. 422, pl. 5, fig. 8.

**Nomenclature.** The holotype (S. G. U. No. 138) is from the Paleocene of Sweden. It was figured by Brotzen (1948, pl. 6, fig. 6).

**Material.** Byala Formation (27 specimens).

**Description.** Test is elongated, tapered at the initial portion, triangular in cross section, triserial. Edges are rounded, sides are slightly depressed. Sutures are oblique, slightly depressed. Aperture is basal, loop-shaped.

**Distribution.** The species is known from the Paleocene of Sweden, Denmark, Poland, the Netherlands, Tunisia, Ukraine, Georgia, Russian Plate, the Upper Paleocene of England.

**Occurrence.** C-21 (29.50-37.00 m – P1b Zone), C-23 (271.20 m – P1b Zone), C-24 (40.00 m – P2 Zone), C-28 (15.00 m – P2 Zone), C-30 (83.90-86.30 m – P4 Zone, 99.50 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP2 Zone), Byala River Valley (Paleocene).

Genus ***Globobulimina*** Cushman, 1927

*Type species. Globobulimina pacifica* Cushman, 1927 (original designation).

*Distribution.* Paleocene – Holocene; cosmopolitan.

***Globobulimina suteri*** (Cushman and Renz, 1946)

Plate I, Figure 11

1947. *Bulimina (Desinobulimina) suteri* Cushman and Renz; Cushman, p. 14, pl. 4, fig. 16.

1962. *Bulimina (Desinobulimina) suteri* Cushman and Renz; Hillebrandt, S. 81, Taf. 5, Fig. 32-34.

*Nomenclature.* I have no data about the holotype.

*Material.* Byala Formation (42 specimens), Emine Formation (1 specimen).

*Description.* Test is oval in outline and round in cross section, triserial. Chambers are inflated, sharply increasing in size. The last row comprises up to 2/3 of the test length. Sutures are indistinctive in the initial part, later they become slightly depressed, curved. Surface is smooth, Aperture is low loop-shaped.

*Distribution.* The species is known from the Maastrichtian, of Trinidad, the Paleocene of Austria, Trinidad, Venezuela, the Eocene of Trinidad.

*Occurrence.* Byala Formation: C-12 (169.70 m – Lower Paleocene, 264.50 m – Lower Paleocene), C-24 (40.00 m – P2 Zone), C-25 (22.50-40.40 m – P1b Zone, 454.60 m – P2 Zone), C-29 (361.10 m – P3 Zone, 433.50-464.70 m – P5 Zone), C-30 (83.90 m – P4 Zone), sections Byala 1 (NP3-4 Zone), Byala 2b (NP3 Zone), Byala 2c (NP2 Zone), Byala River and Koundilaki Cheshme Valleys (Paleocene); Emine Formation: a sample from the geological mapping (Lower Paleocene).

Genus ***Praeglobobulimina*** Hofker, 1951

*Type species. Bulimina pyrula* d'Orbigny var. *spinescens* Brady, 1884 (original designation);

*Distribution.* Late Paleocene - Holocene; cosmopolitan.

*Remarks.* The numerous finds of *P. pyrula* (d'Orbigny) in Senonian and Lower Paleocene emend the genus' range given by Loeblich, Tappan (1988).

***Praeglobobulimina pyrula*** (d'Orbigny, 1846)

Plate I, Figure 6

1846. *Bulimina pyrula* d'Orbigny; d'Orbigny, p. 184, tab. 11, fig. 9, 10.

1846. *Bulimina ovata* d'Orbigny; d'Orbigny, p. 185, tab. 11, fig. 13, 14.

1846. *Bulimina pupoides* d'Orbigny; d'Orbigny, p. 185, tab. 11, fig. 11, 12.

1948. *Bulimina* aff. *ovata* d'Orbigny; Brotzen, p. 59, pl. 10, figs. 9, 10.

1957. *Bulimina ovata* d'Orbigny; Tzaneva, p. 14, pl. 2, fig. 2.

1959. *Bulimina ovata* d'Orbigny; Stancheva, p. 259, pl. 7, fig. 8.

1985. *Bulimina pyrula* d'Orbigny; Papp, Schmidt, p. 69, pl. 62, figs. 2-10.

1992. *Bulimina pyrula* d'Orbigny; Darakchieva, Juranov, p. 24, pl. 4, fig. 8.

1999. *Praeglobobulimina pyrula* (d'Orbigny); Darakchieva, p. 59.

*Nomenclature.* The lectotype (GBA Coll. No. 1981/03/314) was pointed out by Papp, Schmidt (1985, pl. 62, fig. 9). The species was first described from the Miocene of the Vienna Basin.

*Material.* Byala Formation (24 specimens).

*Remarks.* The species was described as *B. ovata* d'Orbigny (Tzaneva, 1957) from the Eocene in NE Bulgaria and the

Miocene of NW Bulgaria (Stancheva, 1959). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992). I accept the Papp, Schmidt's (1985) revision according to which *B. ovata* d'Orbigny and *B. pupoides* d'Orbigny are synonyms of *B. pyrula* d'Orbigny.

*Distribution.* The species is known from the Senonian of Caucasus, the Paleocene of Sweden, Poland, the Netherlands, Turkmenia, the Eocene of Hungary, France, the USA, Belgium, Ukraine, Caucasus, Byelorussia, the Netherlands, the Oligocene of Mexico, the Netherlands, Hungary, the Upper Oligocene and Miocene of Dominican Republic, the Miocene of the Vienna Basin, Hungary, Germany, Florida, the Pliocene of Italy, recent sea sediments in Italy and Philippines.

*Occurrence.* C-11 (191.60 m – P1c Zone), C-21 (7.50 m – P1c Zone), C-23 (271.20 m – P1b Zone), C-29 (395.20–399.20 m – P4 Zone, 440.30-475.30 m – P5 Zone), C-30 (83.90-86.30 m – P4 Zone, 99.50-107.90 m – P5 Zone), sections Byala 1 (NP4 Zone), Byala 2b (NP1-3 Zone).

Superfamily FURSENKOINACEA Loeblich and Tappan, 1961

Семейство FURSENKOINIDAE Loeblich and Tappan, 1961

Род ***Fursenkoina*** Loeblich and Tappan, 1961

*Type species. Virgulina squamuosa* d'Orbigny, 1826 (original designation).

*Distribution.* Late Cretaceous – Holocene; cosmopolitan.

***Fursenkoina*** sp.

Plate I, Figure 7

*Material.* Byala Formation (8 specimens).

*Description.* Test is narrow, elongated, laterally flattened, biserial. Initial portion is twisted, with indistinctive sutures. Sutures in the late portion are slightly depressed, oblique. Surface is smooth. Aperture is low, elongated, slit-like.

*Occurrence.* C-30 (107.90 m – P5 Zone), section Byala 1 (NP5 Zone), Byala 2b (NP1-3 Zone).

Superfamily STILOSTOMELLACEA Finlay, 1947

Family STILOSTOMELLIDAE Finlay, 1947

Genus ***Nodogenerina*** Cushman, 1927

*Type species. Nodogenerina bradyi* Cushman, 1927 (original designation).

*Distribution.* Campanian – Holocene; cosmopolitan.

***Nodogenerina emaciata*** (Reuss, 1851)

Plate I, Figure 12

1851. *D. (Dentalina) emaciata* m.; Reuss, S. 63, Taf. 3, Fig. 9.

1956. *Dentalina emaciata* Reuss; Hagn, S. 136, Taf. 12, Fig. 5.

1979. *Stilostomella emaciata* (Reuss); Sztrakos, pl. 19, fig. 14.

*Nomenclature.* Holotype is the specimen figured by Reuss (1851, Taf. 3, Fig. 9). The species was first described from the Oligocene of Germany.

*Material.* Byala Formation (7 specimens).

*Description.* Test is slim, elongated, uniserial, curved. Chambers are elongated, gradually increasing in size. Initial chamber bears a basal spine. Sutures are straight, horizontal, flush in the initial portion, slightly depressed in the late one. Surface is smooth. All available specimens are with broken aperture.

*Distribution.* The species is known from the Paleogene of Germany, the Oligocene of Hungary.

*Occurrence.* C-24 (74.25 m – P1b Zone), sections Byala 2b (NP3-5 Zone), Byala 2c (NP1-2 Zone).

Genus **Orthomorphina** Stainforth, 1952

*Type species.* *Nodogenerina havanensis* Cushman and Bermudez, 1937 (original designation).

*Distribution.* Eocene – Holocene; cosmopolitan.

*Remarks.* The present find of representatives of the genus in the Paleocene emends the stratigraphical range given by Loeblich, Tappan (1988).

**Orthomorphina rohri** (Cushman and Strainforth, 1945)

Plate I, Figure 13

1945. *Nodogenerina rohri* Cushman and Strainforth, n. sp.; Cushman and Strainforth, p. 39, pl. 5, fig. 26;

1956. *Orthomorphina rohri* (Cushman and Strainforth); Hagn, S. 144, Taf. 13, Fig. 20;

1979. *Orthomorphina rohri* (Cushman and Strainforth); Sztrakov, pl. 14, fig. 9;

1983. *Orthomorphina rohri* (Cushman and Strainforth); Basov, Krashennikov, p. 762, pl. 12, fig. 5.

*Nomenclature.* The holotype (Cushman Coll. No. 43618) is from the Oligocene of Trinidad (Cipero formation, zone III, sample Rz. 425).

*Material.* Byala Formation (2 specimens).

*Description.* Test is straight, uniserial, composed of subspherical chambers with gradually increasing sizes. Sutures are straight, horizontal, depressed. Surface is smooth. Aperture is broken.

*Distribution.* The species is known from the Eocene of Trinidad, North Alps, the Upper Eocene of Barbados, the Lower Oligocene of Barbados, the Oligocene of Trinidad. It was also found during the deep sea drilling in the Southeast Atlantic (Middle Eocene – Oligocene) and Norwegian Sea (Lower Eocene).

*Occurrence.* C-12 (303.40 m – P1b Zone), section Byala 2b (NP3 Zone).

Genus **Siphonodosaria** A. Silvestri, 1924

*Type species.* *Nodosaria abyssorum* Brady, 1881 (subsequent designation by monotypy - Cushman, 1927);

*Distribution.* Eocene - Holocene; cosmopolitan.

*Remarks.* The numerous finds of representatives of the genus in the Senonian and Paleocene emends the stratigraphical range given by (Loeblich, Tappan, 1988).

**Siphonodosaria adolphina** (d'Orbigny, 1846)

Plate I, Figure 14

1846. *Dentalina adolphina* d'Orbigny; d'Orbigny, p. 51, tab. 2, fig. 18-20;

1951. *Dentalina adolphina* d'Orbigny; Spasov, p. 100, pl. 1, fig. 11;

1926. *Nodosaria* cf. *adolphina* (d'Orbigny); Cushman, p. 597, pl. 18, fig. 2;

1969. *Nodosaria adolphina* (d'Orbigny); Krayeva, Zernetskij, p. 41, pl. 14, fig. 6;

1985. *Stilostomella adolphina* (d'Orbigny); Papp, Schmidt, p. 31, pl. 14, figs. 8-11;

1992. *Siphonodosaria adolphina* (d'Orbigny); Darakchieva, Juranov, p. 30, pl. 5, fig. 4.

*Nomenclature.* The lectotype (GBA Coll. No. 1981/03/58) was pointed out by Papp, Schmidt (1985, pl. 14, fig. 9). The species was first described from the Badenian of the Vienna Basin.

*Material.* Byala Formation (1 specimen).

*Remarks.* In Bulgaria the species was described from the Miocene of Kula District (Spasov, 1951). It was also established in the Eocene of Bourgas District (Darakchieva, Juranov, 1992).

*Distribution.* It is known from the Upper Senonian of Germany, the Paleocene of Texas (Midway Formation), Mexico, Poland, the Eocene of Ukraine, Caucasus, Crimea, Turkmenia, California, Venezuela, the Middle Eocene of Dalmatian, the Oligocene of the Netherlands, Hungary, the Miocene of the Vienna Basin, Bavaria.

*Occurrence.* C-30 (83.90 m – P4 Zone).

**Siphonodosaria paleocenica** (Cushman and Todd, 1946)

Plate I, Figure 15

1946. *Ellipsonodosaria paleocenica* Cushman and Todd, n. sp.; Cushman and Todd, p. 61, pl. 10, fig. 26;

1951. *Ellipsonodosaria paleocenica* (Cushman and Todd); Cushman, p. 46, pl. 13, figs. 3-5.

*Nomenclature.* The holotype (Cushman Coll. No. 46415) is from the Paleocene of Little Rock (Arkansas, USA).

*Material.* Byala Formation (6 specimens).

*Description.* Test is slim, elongated, straight, uniserial, slightly tapered in the initial portion, than slightly broadening. It is composed of 11-14 spherical chambers with gradually increasing sizes. Sutures are straight, horizontal, deep. Surface is smooth. Aperture is terminal, round, located on a short neck with lip.

*Distribution.* The species is known from the Paleocene of Arkansas, Alabama, Texas, Mississippi, and Tennessee.

*Occurrence.* Section Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

**Siphonodosaria** sp.

Plate I, Figure 16

*Material.* Byala Formation (49 fragments).

*Description.* The investigated fragments are composed of 4-6 spherical equidimensional chambers separated by deep sutures. In the last 2-3 chambers they turn into short necks. Surface is smooth. Aperture is terminal, round, on a short neck.

*Occurrence.* C-12 (194.10 m – P1c Zone), C-21 (22.00 m – P1b Zone), C-23 (215.00 m – Lower Paleocene), C-24 (40.00 m - P2 Zone, 107.70 m – P1c Zone), C-29 (440.30 m – P5 Zone), C-30 (86.30 m – P4 Zone, 107.90 m – P5 Zone), sections Byala 1 (NP5 Zone), Byala 2b (NP3 Zone), Byala River Valley (Paleocene).

## References

Agip. 1957. Foraminiferi Padani. Atlante iconografico e distribuzione stratigrafica. Milano: *Agip Minararia*. Tav. 1-52.

- Aubert, J., W. A. Berggren. 1976. Paleocene benthic foraminiferal biostratigraphy and paleoecology of Tunisia. – *Bull. Centre Res. Pau - SNPA*, 10, 2, 379-469.
- Basov, I. A., V. A. Krasheninnikov. 1983. Benthic foraminifers in Mesozoic and Cenozoic sediments of the Southeastern Atlantic as an indicator of paleoenvironment, Deep Sea Drilling Project Leg 71. – *Init. Repts. DSDP*, 71, 739-783.
- Berggren, W. A. 1972. Cenozoic biostratigraphy and paleobiogeography of the North Atlantic. – In: *Init. Repts. DSDP*, 12, 965-1001.
- Berggren, W. A. 1974. Late Paleocene-Early Eocene benthonic foraminiferal biostratigraphy and paleoecology of Rockal Bank. – *Micropaleont.*, 20, 4, 426-448.
- Bermudez, P. J. 1949. Tertiary Smaller Foraminifera of the Dominican Republic. – *Cush. Lab. For. Res., Spec. Publ.*, 25, 322 p.
- Braga, G., R. de Biase, A. Grunig, F. Proto Decima. 1975. Foraminiferi bentonici del Paleocene ed Eocene della sezione di Possagno. – *Schweiz. Palaeont. Abh.*, 97, 85-199.
- Brotzen, F. 1948. The Swedish Paleocene and its Foraminiferal Fauna. – *Sverig. Geol. Unders., Ser. C* 493, 4, 2, 3-140.
- Cushman, J. A. 1926. The Foraminifera of the Velasco Shale of the Tampico Embayment. – *Bull. Amer. Ass. Petrol. Geol.*, 10, 581-612.
- Cushman, J. A. 1937. A Monograph of the Subfamily Virguliniinae of the Foraminiferal Family Buliminidae. – *Cush. Lab. For. Res., Sp. Publ.*, 9, 228 p.
- Cushman, J. A. 1947. A Foraminiferal Fauna from the Santa Anita Formation of Venezuela. – *Contrib. Cush. Lab. For. Res.*, 23, 1, 1-18.
- Cushman, J. A. 1951. Paleocene Foraminifera of the Gulf Coastal Region of the United States and Adjacent Areas. – *Geol. Survey Prof. Paper*, 232, 1-75.
- Cushman, J. A., P. J. Bermudez. 1936. Additional New Species of Foraminifera and a New Genus from the Eocene of Cuba. – *Contr. Cush. Lab. For. Res.*, 12, 3, 55-63.
- Cushman, J. A., F. Parker. 1936. Some American Eocene Buliminids. – *Contrib. Cush. Lab. For. Res.*, 12, 2, 39-44.
- Cushman, J. A., R. M. Stainforth. 1945. Foraminifera of the Ciper Marl Formation of Trinidad, British West Indies. – *Cushman Lab. For. Res., Sp. Publ.*, 14, 75p.
- Cushman, J. A., M. R. Todd. 1946. A foraminiferal Fauna from the Paleocene of Arkansas. – *Contrib. Cush. Lab. For. Res.*, 22, 2, 45-65.
- Dam, A., ten. 1944. Die stratigraphische Gliederung des Niederländischen Paläocäns und Eozäns nach Foraminiferen (mit Ausnahme von Sud-Limburg). – *Meded. Geol. Sticht., Ser. C -V*, 3, 5-142.
- Darakchieva, S. 1999. *Small Tertiary Foraminifers from Bulgaria. Atlas*. Sofia, 92 p.
- Darakchieva, S., S. Juranov. 1992. Small Foraminifers from the Middle and Upper Eocene in the Burgas District. Calcareous benthic foraminifers - Part I. – *Geologica Balc.*, 22, 4, 3-42.
- Geroch, S. 1960. Zespół mikrofauny z kriedu I paleogenu serii slasiej w Bescidzie Slaskim. – *Inst. Geol. Biul.*, 153, 5, 1-138.
- Glaessner, M. 1937. Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaukasus. 1. Die Foraminiferen der Ältesten Tertiärschichten des Northwest Kaukasus. – *Problemy paleontologii*, 2-3, 349-410.
- Hagn, H. 1956. Geologische und paläontologische Untersuchungen im Tertiär des Monte Brione und seiner Umgebung (Gardasee, Oberitalien). – *Palaeontographica*, 107, A, 67-210.
- Haynes, J. 1958. Certain Smaller British Paleocene Foraminifera. Part IV. Arenacea, Lagenidea, Buliminidea and Chilostomellidae. – *Contrib. Cush. Found. For. Res.*, 9, 3, 58-77.
- Hillebrandt, A. von. 1962. Das Paleozän und seine Foraminiferenfauna im Becken von Reichenhall und Salzburg. – *Bayer. Acad. Wiss., math-natw. Cl., Abh.*, (N. F.), 108, 1-192.
- Kaptarenko-Chernousova, O. K., P. M. Golyak, B. F. Zemetskij, E. Y. Krayeva, E. S. Lipnik. 1963. Atlas of characteristic Jurassic, Cretaceous and Paleogene foraminifers from the plate part of Ukraine. – *Geol. Inst. Acad. Sci of Ukraine, ser. Stratigr. and paleontol.*, 45, Kijv, 200 p.
- Krayeva, E. Y., B. F. Zemetskij. 1969. Paleogene Foraminifers from Ukraine. – *Paleont. Misc.*, 3, 197 p. (In Russian)
- Loeblich, A. Jr., H. Tappan. 1988. *Foraminiferal genera and their classification*. New York, Van Nostrand Reinhold, 970 p.
- McGowran, B. 1965. Two Paleocene Foraminiferal Faunas from the Wangerrip Group, Pebble Point Coastal Section, Western Victoria. – *Proc. Royal Soc. Victoria*, 79, 1, 9-74.
- Olson, R. K. 1960. Foraminifera of the Latest Cretaceous and Earliest Tertiary Age in the New Jersey Coastal Plain. – *J. Paleontol.*, 34, 1, 1-58.
- Orbigny, A. 1846. *Foraminifères fossiles du bassin Tertiaire de Vienne*. Paris, Gide et Comp., 312.
- Papp, A., A. E. Schmidt. 1985. Die fossilen Foraminiferen des Tertiären Becken von Vien. Revision der Monographie von Alcide d'Orbigny (1846). – *Abh. Geol. Bundesanstalt*, 37, 310 p.
- Pozaryska, K. 1965. Foraminifera and Biostratigraphy of the Danian and Montian in Poland. – *Paleont. Polonica*, 14, 156 p.
- Pozaryska, K., J. Szczechura. 1968. Foraminifera from the Paleocene of Poland, their ecological and biostratigraphical meaning. – *Paleont. Polonica*, 20, 107 p.
- Reuss, A. E. 1851. Über die fossilen Foraminiferen und Entomostraceen der Septarienthone der Umgegend von Berlin. – *Zeitschr. Deutsch. Geol. Gess.*, 3, 49-92.
- Spasov, H. 1951. Torthonian foraminifers from Staropaititsa Area, Kula District. – *Proc. Geol. Inst.*, 1, 103-124 (in Bulgarian).
- Stancheva, M. 1959. Microfaunal characteristics of the Torthonian from the Northwest Bulgaria. – *Treat. Geol. Bulg., Ser. paleont.*, 1, 229-320 (In Bulgarian).
- Sztrakos, K. 1979. La stratigraphie, paléocologie, paléogéographie et les foraminifères de l'Oligocène du Nord-est de la Hongrie. – *Cahiers Micropaleont.*, 3, 1-95.
- Subbotina, N. N. 1947. Danian and Paleogene foraminifers from North Caucasus. – In: *Microfauna from the oil*

- deposits of Caucasus, Emba and Middle Asia*, VNIGRI, 39-160 (in Russian).
- Subbotina, N. N. 1950. Microfauna and stratigraphy of the Elburgan and Goryachij Klyuch Horizon.- In: *Microfauna USSR, Treat.* VNIGRI, 4, 5-112. (In Russian)
- Tjalsma, R. C., G. P. Lohman. 1983. Paleocene-Eocene bathyal and abyssal benthic foraminifera from the Atlantic Ocean.- *Micropaleont., Spec. Publ.*, 4, 90 p.
- Tzaneva, P. 1957. A contribution to the knowledge of Family Biliminidae from the Cretaceous and Tertiary of Northeast Bulgaria. – *Ann. Manag. Geol. Min. Res., A*, 7, 12-32. (In Bulgarian)
- Valchev, B. 2000. Some Representatives of Family Nodosariidae Ehrenberg, 1838 from the Paleocene Part of Bjala Formation (East Balkan Mountains). – *Rev. Bulg. Geol. Soc.*, 61, 1-3, 87-94.
- Valchev, B. 2001. Genus *Nodosaria* Lamarck, 1812 from the Paleocene Part of Bjala Formation (East Balkan Mountains). – *Rev. Bulg. Geol. Soc.*, 62, 1-3, 111-115.
- Valchev, B. 2002. Unilocular foraminifers from the Paleocene of the Coastal Part of East Stara Planina. – *Ann. de l'Univ. de Sofia, Fac. de Geol. et Geogr.*, 95, liv. 1 – Geol., 17-30 (in Bulgarian with abstract in English).
- Valchev, B. 2003. Biostratigraphy of the Paleocene of the Coastal Part of East Stara Planina based on Small Benthic Foraminifera. – *Geologica Balc.*, 33, 1-2, 47-59.
- Valchev, B. 2004a. Paleocene Benthic Foraminiferal Assemblages from the Coastal Part of East Stara Planina. – *Ann. de l'Univ. de Sofia, Fac. de Geol. et Geogr.*, 96, liv. 1 – Geol., 5-19.
- Valchev, B. 2004b. Genus *Lenticulina* Lamarck, 1804 from the Paleocene of the Coastal Part of East Stara Planina. – *Ann. UMG*, 47, Part I – Geol. and Geophys., 51-56.
- Valchev, B. 2004c. Paleocene Vaginulinids (Foraminiferida) from the coastal part of East Stara Planina. – *Ann. de l'Univ. de Sofia, Fac. de Geol. et Geogr.*, 97, liv. 1 – Geol., 161-176.
- Valchev, B. 2005a. Paleocene Pleurostomellids (Foraminiferida) from the Coastal Part of East Stara Planina (East Bulgaria). – *Ann. de l'Univ. de Sofia, Fac. de Geol. et Geogr.*, 98, liv. 1 – Geol., 19-28.
- Valchev, B. 2005b. Paleocene Polymorphinids and Glandulinids (Order *Foraminiferida*) from the Coastal Part of East Stara Planina (East Bulgaria). – *Ann. UMG*, 48, Part I – Geol. and Geophys., 161-165.
- Vassilenko, V. P. 1950. Paleocene foraminifers from the Central part of Dnepr-Donetsk lowering. – In: *Microfauna USSR*, 4, 177-224 (in Russian).

## Appendix

List of the Midway-type taxa from the Paleocene of the Coastal Part of East Stara Planina published in previous articles

<i>Dentalina acuta</i> d'Orbigny	<i>Lenticulina clypeiformis</i> (d'Orbigny)	<i>L. sulcata apiculata</i> Cushman
<i>D. alternata</i> (Jones)	<i>L. degolyeri</i> (Plummer)	<i>Pygmaeoseistron hispidum</i> (Reuss)
<i>Dentalinoides approximata</i> (Reuss)	<i>L. disca</i> (Brotzen)	<i>P. laevis</i> (Montagu)
<i>D. coleii</i> (Cushman&Dusenbery)	<i>L. inornata</i> (d'Orbigny)	<i>P. oxystomum</i> Reuss
<i>D. fallax</i> (Franke)	<i>L. macrodisca</i> (Reuss)	<i>Reussoolina apiculata</i> (Reuss)
<i>Grigelis pyrula longicostata</i> Cushman	<i>L. ovalis</i> (Reuss)	<i>R. emaciata</i> (Reuss)
<i>Laevidentalina communis</i> (d'Orbigny)	<i>L. pseudomamilligera</i> (Plummer)	<i>R. globosa</i> (Montagu)
<i>L. eocenica</i> (Cushman)	<i>L. turbinata</i> (Plummer)	<i>Favulina hexagona</i> (Williamson)
<i>L. glaessneri</i> (ten Dam)	<i>L. vortex</i> (Fichtel&Moll)	<i>Palliolatella crebra</i> (Mathes)
<i>L. laticolis</i> (Grzybowski)	<i>L. wilcoxensis</i> (Cushman&Ponton)	<i>P. orbignyana</i> Seguenza
<i>L. megalopolitana</i> (Reuss)	<i>Marginulinopsis jacksonensis</i>	<i>Globulina gibba</i> d'Orbigny
<i>L. mucronata</i> Neugeboren	(Cushman&Applin)	<i>Guttulina communis</i> d'Orbigny
<i>Nodosaria aspera</i> Reuss	<i>Saracenaria arcuata</i> (d'Orbigny)	<i>G. ipatovcevi</i> Vassilenko
<i>N. concinna</i> Reuss	<i>S. hantkeni</i> Cushman	<i>G. irregularis</i> (d'Orbigny)
<i>N. ewaldi</i> Reuss	<i>Neoflabellina rugosa</i> (d'Orbigny)	<i>G. lidiae</i> Vassilenko
<i>N. guttifer</i> (d'Orbigny)	<i>Astaculus cymbooides</i> (d'Orbigny)	<i>Pyrulinoidea cylindroides</i> (Roemer)
<i>N. (?) hispida</i> (Soldani)	<i>A. gibbus</i> (d'Orbigny)	<i>Ramulina globulifera</i> Brady
<i>N. longiscata</i> d'Orbigny	<i>A. gladius</i> (Philippi)	<i>Glandulina laevigata</i> d'Orbigny
<i>N. praegnans</i> (Reuss)	<i>Hemirobulina pediformis</i> (Bornemann)	<i>Ellipsoglandulina chilotoma</i> (Rzehak)
<i>N. radricula</i> (Linne)	<i>Marginulina apiculata</i> Reuss	<i>E. manifesta</i> Franke
<i>N. soluta</i> Reuss	<i>M. hamulus</i> Chapman	<i>Ellipsoidina ellipsoidea ellipsoidea</i>
<i>Pseudonodosaria caudigera</i> (Schwager)	<i>M. hirsuta</i> d'Orbigny	Seguenza
<i>P. cylindracea</i> (Reuss)	<i>M. obliqua</i> (d'Orbigny)	<i>E. ellipsoidea oblonga</i> Seguenza
<i>P. manifesta</i> (Reuss)	<i>M. oblonga</i> Kaptarenko	<i>Ellipsopolymorphina velascoensis</i>
<i>P. parallela</i> (Marson)	<i>M. similis</i> d'Orbigny	(Cushman)
<i>Pyramidulina latejugata</i> (Guembel)	<i>Marginulina</i> sp.	<i>Nodosarella hedbergi</i> Cushman and Renz
<i>P. raphanistrum</i> (Linne)	<i>Vaginulinopsis earlandi</i> (Plummer)	<i>N.cf. paleocenica</i> Cushman and Todd
<i>P. raphanus</i> (Linne)	<i>V. longiformis</i> (Plummer)	<i>N. tuberosa</i> (Gümbel)
<i>P. tutkowskii</i> (Kaptarenko)	<i>V. midwayana</i> (Fox&Ross)	<i>Nodosarella</i> sp.
<i>Fronidularia jarvisi</i> Cushman	<i>V. pedum</i> (d'Orbigny)	<i>Pleurostomella eocaena</i> Gümbel
<i>Fronidularia</i> sp. 1	<i>Hyalinonetrion clavatum</i> (d'Orbigny)	<i>P. kugleri</i> Cushman and Renz
<i>Fronidularia</i> sp. 2	<i>Lagena costata</i> (Williamson)	<i>P. paleocenica</i> Cushman
	<i>L. sulcata</i> (Walker&Jakob)	<i>P. subnodosa</i> (Guppy)

## Plate I

- 1, 2. ? *Textularia plummerae* Lalicker, 1935. Byala Formation, Section Byala 2c, Lower Paleocene, NP2 Zone, Sample 52c-8; SEMx42.6
3. *Textularia* sp. Byala Formation, C-25, Lower Paleocene, 40.40 m, P1b Zone, Sample C-25-6; SEMx37.4
4. *Pyramidulina tenuicostata* (Cushman & Bermudez, 1936). Byala Formation, Koundilaki Cheshme Valley, Paleocene, Sample K4-1; SEMx65.5
5. *Bolivina midwayensis* Cushman, 1936. Byala Formation, Section Byala 2b, Lower Paleocene, NP1 Zone, Sample 52b-7; SEMx50.5
6. *Praeglobobulimina pyrula* (d'Orbigny, 1846). Byala Formation, C-29, Upper Paleocene, 440.30 m, P5 Zone, Sample C-29-11; SEMx63
7. *Fursenkoina* sp. Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample 52b-14; SEMx75
8. *Dentalina longicostata* (Cushman & Jarvis, 1934). Byala Formation, Byala River Valley, Paleocene, Sample BP-6; SEMx48=6
9. *Bulimina midwayensis* Cushman & Parker, 1936. Byala Formation, C-29, Upper Paleocene, 399.20 m, P4 Zone, Sample C-29-8; SEMx63
10. *Bulimina paleocenica* Brotzen, 1948. Byala Formation, Section Byala 1, Lower Paleocene, NP3 Zone, Sample 51-12; SEMx71.5
11. *Globobulimina suteri* (Cushman & Renz, 1946). Byala Formation, Section Byala 2b, Lower Paleocene, Sample 52b-17; SEMx60
12. *Nodogenerina emaciata* (Reuss, 1851). Byala Formation, Section Byala 2b, Lower Paleocene, NP1 Zone, Sample 52b-8; SEMx48.6
13. *Orthomorphina rohri* (Cushman & Stainforth, 1945). Byala Formation, Section Byala 2b, Lower Paleocene, NP2 Zone, Sample 52b-13; SEMx81.5
14. *Siphonodosaria adolphina* (d'Orbigny, 1846). Byala Formation, C-30, Upper Paleocene, 83.90 m, P4 Zone, Sample C-30-6; SEMx48.6
15. *Siphonodosaria paleocenica* (Cushman & Todd, 1946). Byala Formation, Section Byala 2b, Lower Paleocene, NP3 Zone, Sample 52b-17; SEMx63
16. *Siphonodosaria* sp. Byala Formation, Byala River Valley, Paleocene, Sample BP-7; SEMx63

Recommended for publication by the Department of  
Geology and Paleontology, Faculty of Geology and Prospecting



PLATE I

