

# An emendation of some Cretaceous species of "*Reophax*" (Foraminiferida) from northwest Europe and Poland

STANISLAW GEROCH<sup>1</sup> and MICHAEL A. KAMINSKI<sup>2</sup>

1. Institute of Geological Sciences, Jagiellonian University ul. Oleandry 2a, 30-063 Kraków, Poland.

2. Research School of Geological and Geophysical Sciences, Birkbeck College and University College London, Gower Street, London WC1E 6BT, U.K.

## ABSTRACT

The classification of some deep-water agglutinated foraminifera identified as *Reophax minuta* Tappan, 1940 is revised based upon examination of type material. Lower Cretaceous specimens formerly placed in *Reophax minuta* from northwest Europe and the Polish Carpathians in actuality belong in *Pseudonodosinella troyeri* (Tappan, 1960). Upper Cretaceous forms formerly referred to *R. minuta* are now placed in *Pseudonodosinella parvula* (Huss, 1966). A neotype for *Pseudonodosinella parvula* is designated herein.

## INTRODUCTION

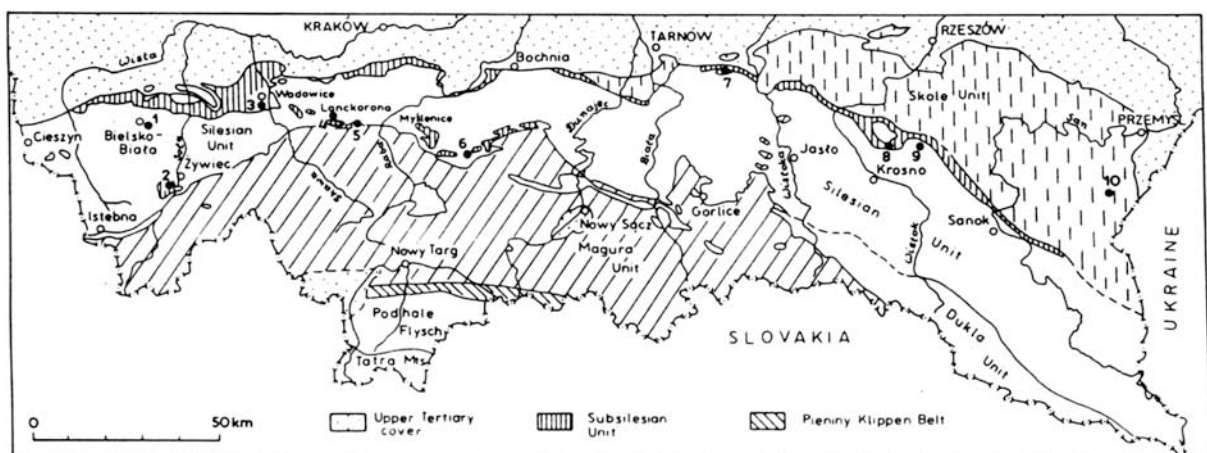
Some tapered specimens of *Reophax* referred to the species *R. minuta* Tappan, 1940 are commonly encountered in deep-water sediments of Cretaceous to Paleogene age. In the biostratigraphic schemes of the Polish Carpathians (Geroch & Nowak, 1984) and North Sea (King *et al.*, 1989), "*R. minuta*" is used as zonal index taxon for the upper Barremian to Aptian, and the upper Aptian to lower Albian, respectively. However, the type specimens of *Reophax minuta* housed at the US Natural History Museum in Washington DC are derived from comparatively shallow facies from the Coastal Plain of Texas. The "true" *Reophax minuta* possesses numerous, regularly enlarging chambers, horizontal sutures, lacks an apertural neck, and does not display the characteristic tapered morphology of specimens known from deep-water deposits. These specimens from the Cretaceous of Texas were designated the type species of the genus *Scherchorella* Loeblich & Tap-

pan, 1984. Despite the fact that Loeblich & Tappan (1984, 1987) regarded these forms as distinct from typical deep-water *Reophax*, some confusion has persisted in the recent literature with regard to the systematics of deep-water and boreal specimens.

The primary purpose of this paper is to document the Cretaceous deep-water species of *Reophax* known from the North Sea area and the Polish Carpathian flysch and to revise their taxonomy based on direct comparison to type material in the collections of the US Natural History Museum.

## MATERIAL

In this study we concentrated our efforts to determine the taxonomic affinity of specimens normally lumped in *Reophax minuta*, by examining specimens housed in the "primary types" collection at the US Natural History Museum as well as specimens from various localities in the Carpathians (Fig. 1). One species, *Reophax parvulus* Huss, 1966, previously



**Figure 1.** Tectonic units of the Polish Outer Carpathians (modified after Książkiewicz, 1968), with localities indicated. 1- Straconka, Lipnik, 2- Zywiec, 3- Zawadka, 4- Lanckorona, 5- Sulkowice, 6- Wilkowisko, 7- Wiernik, 8- Węglówka, 9- Domaradz, 10- Rybotycze.

named *R. minuta* Tappan (Huss, 1957), was originally described from the Carpathians. Unfortunately, Huss never deposited type specimens in any museum, and her collection no longer exists. However, Huss did provide an adequate description and illustrations (Textfig. 2). Luckily, some foraminiferal assemblages picked from boreholes from the type area Wegłówka near Krosno described in her papers (Huss, 1957; 1966) were at our disposal.

### SYSTEMATIC DESCRIPTIONS

Family HORMOSINIDAE Haeckel, 1894

Subfamily Hormosiniinae Haeckel, 1894

Genus *Pseudonodosinella* Saidova, 1970

The genus *Pseudonodosinella* (type species *Reophax nodulosa* Brady, 1879) is characterised by its smooth, finely finished wall comprised of a multiple layer of grains, ovate to subpyriform chambers with horizontal sutures, and a terminal aperture "at the centre of a thickened wall and produced face".

#### *Pseudonodosinella troyeri* (Tappan, 1960)

Plate 1, Figs. 1, 2, 4-16

*Reophax troyeri* Tappan, 1960, p. 291, pl. 1, figs. 10-12. - Tappan, 1962, p. 153, pl. 30, figs. 11-13.

*Haplostiche* D1 Hecht, 1938, pl. 3a, figs. 24-26; pl. 4a, figs. 4-8; pl. 6a, fig. 29.

*Reophax* cf. *minuta* Tappan. - Geroch, 1960, p. 123, pl. 6, figs. 2, 3.

*Reophax minutus* Tappan. - Bartenstein & Bettenstaedt, 1962, p. 282, pl. 39, fig. 1. - Geroch, 1966, p. 439, fig. 7 (7-17). - Grün *et al.*, 1972, pl. 5, fig. 6. - Geroch & Nowak, 1984, pl. 1, fig. 9.

*Reophax minuta* Tappan. - Bach, 1965, p. 7, pl. 1, fig. 1. - Hanzliková, 1966, p. 103, pl. 1, figs. 15-16. - Bleachu *et al.* 1968, p. 148, pl. 2, fig. 12. - King *et al.*, 1989, pl. 8.1, fig. 19.

*Reophax liassicus* Franke. - Geroch, 1966, p. 440, fig. 7 (1, 4-6).

**Holotype.** Deposited in the "Primary Types" collection at the US Natural History Museum.

**Description.** Test straight or arched very slightly, tapered at both ends, consisting of 3-6 rapidly enlarging chambers, with horizontal sutures. Microsphaeric forms have as many as six chambers, megalosphaeric forms usually have only three chambers. Aperture single, terminal, on a low, broad neck. The wall is thickened around the aperture. Wall finely agglutinated, comprised of a multiple layer of grains, finely finished.

**Remarks.** This species was originally illustrated as "*Haplostiche* D1" by Hecht (1938) from outcrops in northwest Germany. In his revision of Hecht's classic fauna, Bartenstein (1952, 1962, 1965) assigned Hecht's specimens to *Reophax minuta* Tappan, 1940. Most subsequent workers (including ourselves) have adopted the name *R. minuta* for Cretaceous specimens of *Reophax* that possess an aperture on a produced neck.

However, the type specimens of *R. minuta* from the Albian Grayston Formation of the Texas Coastal Plain possess numerous rounded chambers and no sign of a neck. Loeblich & Tappan (1984) placed these specimens in their new genus *Scherochorella*, which differs from *Reophax* in possessing broad, low

chambers, horizontal sutures, and in lacking a neck. Although the genus is characterised by the absence of a neck, Loeblich & Tappan (1987) retained *Scherochorella* in the subfamily Reophacinae Cushman, 1910, which is described as possessing a rounded, terminal aperture on a distinct neck.

Specimens formerly assigned to *R. minuta* from Lower Cretaceous deposits of northwest Europe and the Carpathian Flysch, however, are tapered at both ends and have a produced aperture. These most closely correspond to the type specimens of *Reophax troyeri* Tappan, 1960, described from the Lower Cretaceous of the Arctic slope of Alaska. We transfer this species to the genus *Pseudonodosinella* because of its general similarities to the type species *P. nodulosa* (Brady). Specimens of *P. troyeri* clearly have a finely agglutinated, multilayered wall, and the typical thickening of the wall around the aperture.

#### *Pseudonodosinella parvula* (Huss, 1966)

Plate 2, Figs. 1-19; Textfig. 2

*Reophax parvulus* Huss, 1966, p. 21, pl. 1, figs. 26-30.

*Reophax* sp. cf. *R. minutus* Tappan. - Geroch & Gradzinski, 1955, pl. 5, fig. 4.

*Reophax minuta* Tappan. - Neagu, 1970, p. 35, pl. 2, fig. 4.

*Reophax* sp. 2. Kaminski *et al.*, 1988, p. 187, pl. 3, figs 2, 3. - Kuhnt, 1990, p. 324, pl. 3, figs. 7-9.

**Type material.** The specimens illustrated by Huss (1966) were originally deposited at the GEONAFITA offices in Krakow, but the collection is now presumed lost. A neotype, designated herein, is illustrated in Plate 2, fig. 1. This specimen is housed in the Micropaleontology collections of the Jagiellonian University. It was selected from Borehole 7 at Wegłówka, which was the same material studied by Huss. The material is derived from upper Cenomanian to Turonian green variegated shales and marly shales of the Subsilesian Unit of the Polish Carpathians. Additional specimens were selected from lower Senonian variegated and red marly shales from the Subsilesian Unit at Zawadka, near Wadowice.

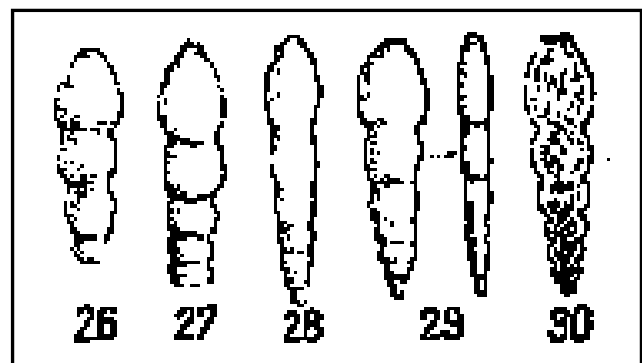


Figure 2. Type specimens of "*R. parvulus*" reproduced from Huss (1966).

**Description.** Test straight or arched very slightly, with oval to pyriform chambers, with horizontal sutures. Microsphaeric forms have as many as eight chambers, whereas megalosphaeric forms typically have four. Aperture single, terminal, on a low, broad

neck. The wall is thickened around the aperture. Wall finely agglutinated, comprised of a multiple layer of grains, finely finished.

**Remarks.** The species "*R. parvulus*" has until now have only been reported from Poland. In her original description of the species, Huss (1966) remarked that it differs from *R. minuta* in having fewer, less rounded chambers. Our specimens from the Polish Carpathians are derived from the Turonian and lower Senonian of the Subsilesian Unit, but this type of slender *Pseudonodosinella* with a tapered last chamber is also known from Paleocene deposits in Trinidad (Kaminski *et al.*, 1988) and from the Campanian to Paleocene at Gubbio, Italy (Kuhnt, 1990).

This Upper Cretaceous to Paleocene species is no doubt closely related to *P. troyeri*, and there is some overlap between the two forms. However, microsphaeric specimens of *P. parvula* are generally more slender and have more elongated chambers than the Lower Cretaceous forms assigned to *P. troyeri* (Fig. 3). Megalosphaeric forms tend to have more slowly enlarging chambers than those of *P. troyeri*, and as a result have nearly parallel sides.

Subfamily Reophacinae Cushman, 1910

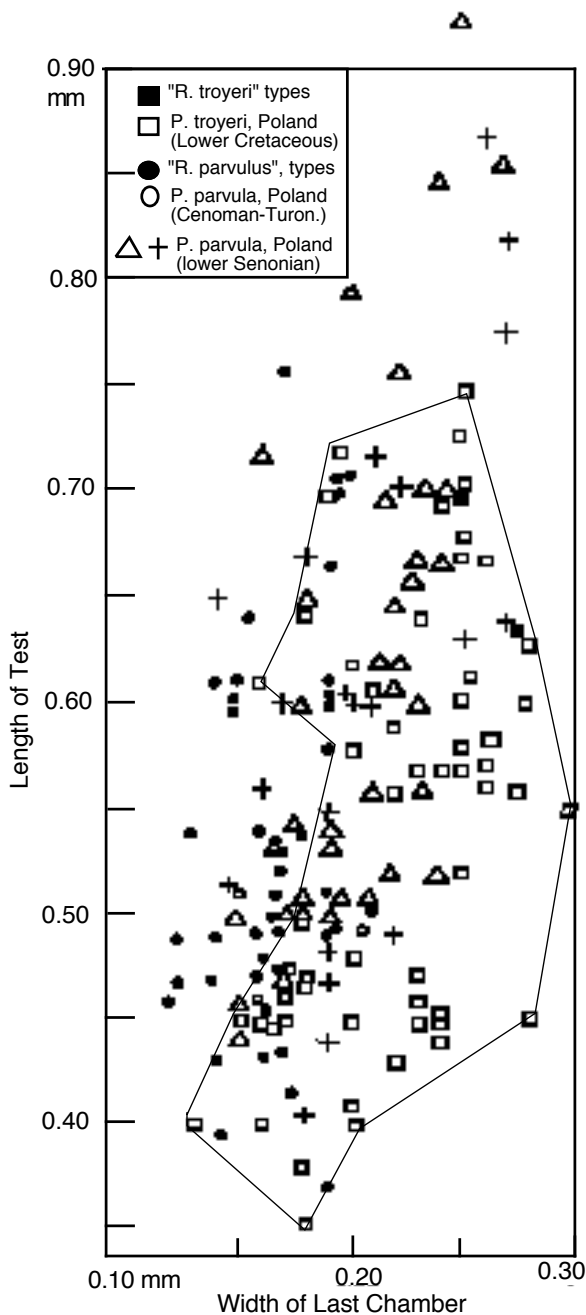
Genus *Scherochorella* Loeblich & Tappan, 1984

*Scherochorella minuta* (Tappan, 1940)

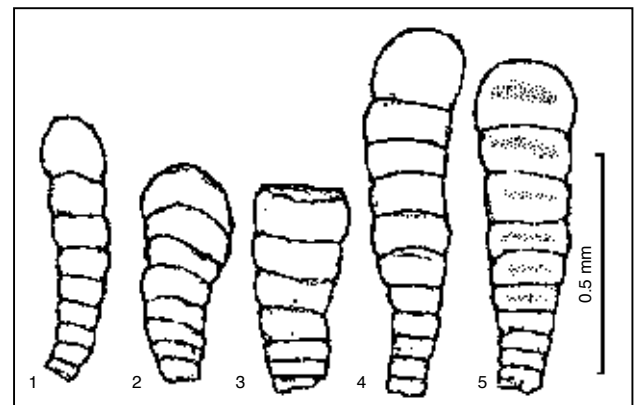
Pl. 1, Fig. 3; Textfig. 4

*Reophax minuta* Tappan, 1940, p. 94, pl. 14, figs. 4a-b. - Tappan, 1943, p. 480, pl. 77, fig. 4.

**Remarks:** Our concept of this genus and species is in full agreement with the description given by Loeblich & Tappan (1987). Several slides of previously unfigured paratypes and metatypes from the U.S. Gulf Coast and the North Slope of Alaska are housed in the collections of the USNM. Specimens are from the Duck Creek Formation of Oklahoma, the Grayson Formation of Texas, and the Torok Formation of Alaska.



**Figure 3.** Dimensions of *P. parvula* and *P. troyeri* from various localities in the Polish Carpathians, compared with the type specimens. Field delineates the aspect ratios of *P. troyeri*.



**Figure 4.** *Scherochorella minuta* (Tappan) from the Cushman Collection (camera lucida sketches). 1. paratype from the Grayson Formation, 3 1/2 mi NE of Koanoke, 2 mi E of Fort Worth - Denton road, Denton County Texas. 2-5. metatypes from the Duck Creek Formation, Red River, Horseshoe Bend, Love County Oklahoma.

**CONCLUSIONS**

The term "*Reophax minutus*" must be restricted to shallow water forms originally described from the Coastal Plain of the Gulf Coast. Deep-water and boreal forms display a more tapered morphology with a produced aperture. Specimens from the North Sea and the Polish Outer Carpathians are sufficiently different from the type specimens of *R. minuta* to warrant being placed in two different species based on the degree of expansion of the width of the test and the height of the final chamber. Lower Cretaceous deep-water forms formerly attributed to "*R. minutus*" are transferred to the species *Pseudonodosinella troyeri* (Tappan). The more slender Upper Cretaceous to Paleocene specimens are now placed in *Pseudonodosinella parvula* (Huss).

## ACKNOWLEDGEMENTS

This study was accomplished through the financial assistance of the Short-Term Visiting Fellowship Program of the Smithsonian Institution. We extend our gratitude to Drs. Martin Buzas and Brian Huber for their hospitality and assistance during our visit to the Smithsonian in December 1991. This is contribution no 42 of the Deep-Water Agglutinated Foraminifera Project.

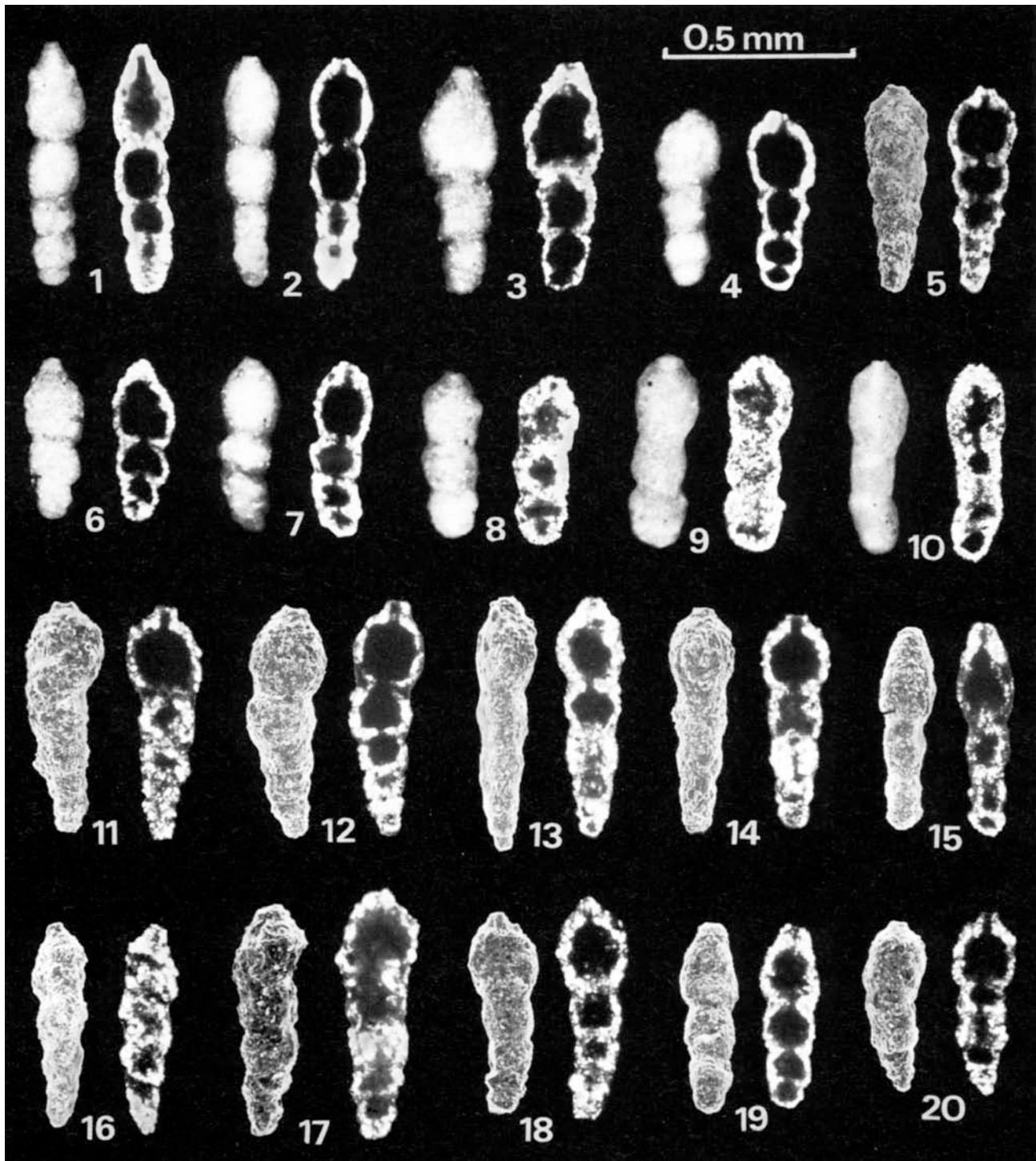
## REFERENCES

- Bach, I. 1965. Mikrofauna und Stratigraphie der Unterkreide im Gebiet des Kleinen Fallsteins bei Osterwieck. *Geologie. Zeitschrift für das Gesamtgebiet der geologischen Wissenschaften, Jahrgang 14, Beiheft 51*, 1-65.
- Bartenstein, H. 1952. Taxonomische Revision und Nomenklatur zu Frank E. Hecht "Standard-Gliederung der Nordwestdeutschen Unterkreide nach Foraminiferen" (1938). Teil 1. Hauterive. *Senckenbergiana*, **33**, (1-3), 297-312.
- Bartenstein, H. 1962. Taxonomische Revision und Nomenklatur zu Frank E. Hecht "Standard-Gliederung der Nordwestdeutschen Unterkreide nach Foraminiferen" (1938). Teil 3: Apt. *Senckenbergiana Lethaea*, **43**, (2), 125-134.
- Bartenstein, H. 1965. Taxonomische Revision und Nomenklatur zu Frank E. Hecht "Standard-Gliederung der Nordwestdeutschen Unterkreide nach Foraminiferen" (1938). *Senckenbergiana Lethaea*, **46**, 327-366.
- Bartenstein, H. & Bettenstaedt, F. 1962. Marine Unterkreide (Boreal and Tethys). In: Simon, W. & Bartenstein, H. (eds.): *Leitfossilien der Mikropaläontologie*. Gebrüder Borntraeger, Berlin, 225-298.
- Bleachu, M., Babucea, Y. & Piliuta, A.-M. 1968. Contribuții la Microbiostratigrafia Eocretacicului din Muntii Metaliferi. *Acad. Repub. Populare Romîni, Studii și Cercetări de Geol. Geofiz. Geograf. ser. Geol.* **13**, (1), 137-155.
- Geroch, S. 1960. Microfaunal assemblages from the Cretaceous and Paleogene Silesian Unit in the Beskid Ałaski Mts. (western Carpathians). *Biuletyn Instytutu Geologicznego*, **153**, 7-138. Warszawa.
- Geroch, S. 1966. Lower Cretaceous small foraminifera of the Silesian series, Polish Carpathians. *Rocznik Polskiego Towarzystwa Geologicznego*, **36**, 413-480.
- Geroch, S. & Gradziński, R. 1955. Stratygrafia serii pod-Éłaskiej "ywieckiego okna tektonicznego. [Stratigraphy of the Sub-silesian series of the "ywiec tectonic window] *Rocznik Polskiego Towarzystwa Geologicznego*, **24**, 3-62.
- Geroch, S. & Nowak, W. 1984. Proposal of Zonation for the late Tithonian - late Eocene, based upon arenaceous foraminifera from the outer Carpathians, Poland. In: Oertli, H., (Ed.) *Benthos '83; 2nd International Symposium on Benthic Foraminifera Pau (France), April 11-15, 1983*. Elf Aquitaine, ESSO REP and TOTAL CFP, Pau & Bourdeaux, pp. 225-239.
- Grün, W., Kittler, G., Lauer, G., Papp, A. & Schnabel, W. 1972. Studien in der Unterkreide des Wienerwaldes. *Jahrbuch der geologischen Bundesanstalt*, **115**, 103-186.
- Hecht, F.E. 1938. Standard-Gliederung der Nordwestdeutschen Unterkreide nach Foraminiferen. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, **443**, 3-42 + 21 pl.
- Huss, F. 1957. Stratygrafia jednostki W'glówki na podstawie mikrofauny [Stratigraphy of the W'glówka Unit based on microfauna]. *Acta Geologica Polonica*, **7**, 29-69.
- Huss, F. 1966. Otworknice aglutynujące serii pod-Éłaskiej jednostki roponoÉnej W'glówki (Polskie Karpaty Fliszowe) [Agglutinated foraminifera of the oil-bearing Sub-silesian series in W'glówka (Polish Flysch Carpathians)]. *Prace Geologiczne, Polska Akademia Nauk*, **34**, 7-76.
- Kaminski, M.A., Gradstein, F.M., Berggren, W.A., Geroch, S. & Beckmann, J.P. 1988. Flysch-type agglutinated foraminiferal assemblages from Trinidad: Taxonomy, Stratigraphy and Paleobathymetry. In: Proceedings of the Second Workshop on Agglutinated Foraminifera, Vienna 1986. *Abhandlungen der Geologischen Bundesanstalt*, **41**, 155-228.
- King, C., Bailey, H.W., Burton, C. & King, A.D. 1989. Cretaceous of the North Sea. In: Jenkins, D.G. & Murray, J.W. (Eds.). *Stratigraphical Atlas of Fossil Foraminifera, second edition*. Ellis Horwood Ltd, 372-417.
- Loeblich, A.R. & Tappan, H. 1984. Some new proteinaeous and agglutinated genera of Foraminiferida. *Journal of Paleontology*, **58**, 1158-1163.
- Loeblich, A.R. & Tappan, H. 1987. *Foraminiferal genera and their classification*. Van Nostrand Reinhold Company, 2 vols., 970 + 212 pp, 847pl., New York.
- Kuhnt, W. 1990. Agglutinated foraminifera of western Mediterranean Upper Cretaceous pelagic limestones (Umbrian Apennines, Italy, and Betic Cordillera, Southern Spain). *Micropaleontology*, **36**, 297-330.
- Książkiewicz, M. 1968. *Geology of the Polish Flysch Carpathians*. Int. Geol. Congress XXIII Session, Prague 1968. Guide to Excursion no. C44 Poland. Wyd. Geol. Warsaw, 73 pp.
- Neagu, T. 1970. Micropaleontological and stratigraphical study of the Upper Cretaceous deposits between the upper valleys of the Buzau and Riul Negru Rivers (Eastern Carpathians). *Memorii Institutul Geologic*, **12**, 7-109. Bucarest.
- Tappan, H. 1940. Foraminifera from the Grayson Formation of northern Texas. *Journal of Paleontology*, **14**, 93-126.
- Tappan, H. 1943. Foraminifera from the Duck Creek Formation of Oklahoma and Texas. *Journal of Paleontology*, **17**, 476-517.
- Tappan, H. 1960. Cretaceous biostratigraphy of northern Alaska. *American Association of Petroleum Geologists, Bulletin*, **44**, 273-297.
- Tappan, H. 1962. Foraminifera from the Arctic Slope of Alaska. Part 3, Cretaceous Foraminifera. *United States Geological Survey Professional Paper*, **236C**, 91-209, pl. 29-58.





**Plate 1.** *Pseudonodosinella troyeri* (Tappan). Specimens on left are photographed using reflected light or SEM; right - same specimen viewed in cross-polarised light. 1-2. Holotype & Paratype of *Reophax troyeri*, Topagoruk Fm. of Alaska. 3. Holotype of *Reophax minuta*. from Tappan (1940). 4a-16. Specimens from the Verovice Beds (Barremian to Albian) of the Polish Carpathians. 4. Wilkowisko MK 60, Silesian Unit; 5. Zywiec JL38/91, Subsilesian Unit; 6. Rybotycze 26/58; Skole Unit; 7-9, 15, 16. Straconka BL8/89; Silesian Unit; 10. Lanckorona, Silesian Unit; 11-12. Straconka 20/91, 41/91; Silesian Unit; 13-14. Lanckorona C9, A3; Silesian Unit;



**Plate 2.** *Pseudonodosinella parvulus* (Huss), Subsilesian Unit of the Polish Carpathians. Specimens on left are photographed using reflected light or SEM; right - view in cross-polarised light. 1-9. Green and variegated upper Cenomanian to Turonian shales, W'glówka boreholes. 1. Neotype, W'glówka-7, 299-303 m. 2,4,6. W'glówka-130, 230 m. 3,5. W'glówka-6a, 241.6 - 247 m. 7-9. W'glówka-6a, 251.6 - 257.4 m. 10-19. Lower Senonian red variegated marly shales, Stream banks at Zawadka near Wadowice.